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THE AMERICAN GAS LIGHT JOURNAL

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[OFFICIAL NOTICE.]

Twenty-first Annual Meeting, American Gas Light Association.

AMERICAN GAS LIGHT ASSOCIATION, OFFICE OF SECRETARY, PROVIDENCE, R. I., September 30th, 1893.

To all Members: The Twenty first Annual Meeting of the American Gas Light Association will be held in Chicago, Ills., beginning October 18th, 1893. The headquarters will be at the Victoria Hotel. The meeting will be called to order at 10 o'clock, on the morning of Wednesday, October 18th, in Kinsley's Hall, 105 Adams street, by the President, A. E. Boardman.

The following papers will be read:

1. "The Revivification of Iron Oxide," by Geo. T. Thompson, St. Louis, Mo.

2. "Gas Engines in the United States," by Fred. H. Shelton, Philadelphia, Pa.

3. "Rate of Purification," by J. A. P. Crisfield, Savannah, Ga.

4. "Relation of Temperature to Purification," by Jas. Somerville, Indianapolis, Ind.

And two others are conditionally promised.

This year the questions submitted for the Question Box will be printed and sent out with the papers, so that if you have any queries to propose, send them to the Secretary *at once.*

The meetings of the Association will be held at Kinsley's Hall, No. 105 Adams street.

Special attention is directed to the Bulletin Board which will be placed in the lobby of the Victoria Hotel, as there will be some very important notices in regard to the meeting, which may be condensed into one day, in which case an evening session may be called.

Cards will be provided at the door for the members and visitors to register as they enter the meeting room for the *first* time, thereby obviating the necessity for the roll call. Name and post office address to be written on the card, which will be taken up by the doorkeeper.

The Committee of Arrangements not having yet reported the details of their work, the Secretary is unable to announce their programme.

Hotel accommodations must be applied for at once by those who have not already secured them. The Victoria will accommodate 50 at $2.50 per day and upwards, and in the immediate neighborhood of the hall are the following, which can accommodate as follows:

Great Northern	25	guests at	$2.00	per day	and	upwards.
Gore's Hotel...	25	"	1 75	"	"	"
McCoy's " ...	75	"	1.75	"	"	"
Saratoga " ...	75	"	1.50	"	"	"

These, like the Victoria, are all on the European plan. The Grand Pacific Hotel can take at most 150 at from $5 per day up, on the American plan, while a few may go to the Auditorium Hotel at from $8 a day up. Accommodations may also be had near the Fair grounds, in good hotels too numerous to specify.

Those New England members who desire to make up a special car or cars, should notify the Secretary at once how many seats they will take, and he will advise them as to prices, accommodations, etc., as much depends on how many tickets will be taken. If an insufficient number respond, no special car will be provided, and those who do write will then be so notified.

As by the Constitution all dues are payable in advance, your bill is inclosed herewith, and if you will remit immediately, payable to A. B. Slater, Jr., Treasurer, you will help much toward relieving that unfortunate official of the rush which always taxes him severely at the meetings.

The Secretary especially calls the attention of those members whom it may concern to the fact that, in accordance with the Constitution, all members whose dues remain unpaid for a term of three years, will be dropped from the rolls.

All applications must be in the Secretary's hands by October 8th, to be acted on at this meeting.

Respectfully, A. B. SLATER, JR., Secretary.

[OFFICIAL NOTICE]

Call for Council Meeting.

AMERICAN GAS LIGHT ASSOCIATION, OFFICE OF SECRETARY,
PROVIDENCE, R. I., September 30th, 1893.

To the Members of the Council: There will be a meeting of the Council of this Association in the Victoria Hotel, Chicago, Ills., at 7 P.M. sharp on October 17th, 1893, for the transaction of the usual and such other business as may be brought before it.

Respectfully, A. B. SLATER, JR., Secretary.

BRIEFLY TOLD.

SECRETARY SLATER'S SECOND CIRCULAR.—In this issue appears the second official announcement from Secretary Slater's pen respecting the 21st annual meeting of the American Association, from which it will be seen that the preparations for the convention are in a satisfactorily forward stage—as was to be expected, when thought was given to the caliber of the men who had in charge the arranging of the details While the paper list presented promises only four set contributions, it is nevertheless more than probable that the number will eventually be increased to six, which, with President Boardman's annual message, to say nothing about the Question Box, will take up every moment of time that can be devoted to the technical side of the sessions. We are of the opinion that Mr. Boardman will have something well out of the common to say in his message; for the brisk Georgian is a man of pronounced beliefs and positive courage. The entertainment programme has not been completed by the local committee; nor is it hardly in order to expect from their hands any diversified system of entertaining, in that the White City will afford the outing magnet for the visitors. Undoubtedly its drawing powers will be sufficient to hold the delegates during their stay in the Windy City. If the Committee resolve themselves into a steering committee, they will not only have enough to do but they will also have fulfilled every obligation that could reasonably be expected of them. From an enumeration of the number of guests that the named hotels will receive—the six listed guarantee to house 400 persons—no fear need be held about lack of sleeping quarters and acceptable provision for the inner man. Still, it should be borne in mind that quarters ought to be secured as far in advance as possible, in order that "all the comforts of home" may be assured. There is more than a probability that the far Eastern contingent will have a special car or cars at their disposal, as hinted by Mr. Slater.

THE DETROIT COMPANY SAYS, "NO."—Elsewhere will be found the full text of the reply of the proprietors of the Detroit Gas Company to the local authorities, in which they refuse to accept the conditions for carrying on their business, as imposed by the ordinance passed in mid-August. The causes which impel and compel the Company to refuse are plainly and separately set forth; and those not directly interested in the situation, but who have given the same fair consideration, either from the standpoint of the city or of the Company, are likely to agree that the Company has much the better of the contention. It will be hard for even so prejudiced a man as Mayor Pingree—whose assault on the Gas Company is largely based on personal and political differences with individuals concerned in the Company's welfare—to fail to see the fairness of the bald facts set forth; yet if the Mayor and his allies persist in their unwillingness to be convinced, the courts of the State may be confidently asked to decree to the Company that which justice declares is its own.

NOTES.—We are credibly informed that something new and great in the instance of gas purification is going on at Hartford, Conn. When the proper time comes we shall tell the story.——Mr. Peter Bauer has been appointed Superintendent of the Texarkana (Tex.) Gas and Electric Light Company.——The Economic Gas Company, of Seattle, Wash., has been incorporated by Messrs. J. H. Elder, S. N. Ford, Geo. R. Coules, T. B. Hardin and Andrew Knox. It is capitalized in $500,000. ——We are informed that Messrs. John Coates & Co., who are behind the opposition Gas Company for Montreal, have been awarded a contract for the public lighting of that city. It is said that the new works will be completed by December 1st, 1893, and the contract for the erection of the same is in the hands of the Economical Gas Apparatus Construction Company, Limited, of Toronto.

[Prepared for the JOURNAL, by Mr. WILLIAM E. MCKAY.]

The Standard Oil Company's World's Columbian Exhibit.

Entering the building of Mines and Mining, through the main doorway in the north wall, the visitor to the World's Columbian Exhibition has his attention attracted by a modest card basket, on the left hand of the way, attached to which is displayed an invitation to "take one" of the contained circulars. This card further invites you to visit the exhibit of the Standard Oil Company, and conspicuously posted on the walls above you are explicit directions to facilitate the finding of the exhibit, which is located on the second floor of the building, along the eastern portion of the north wall. You are notified that lectures, descriptive of the exhibit, will usually be given at 10 or 11 A. M. and at 3 P. M. daily.

At the times of these lectures, and at other times, through the attentive courtesy of Mr. MacGonagle, the gentleman there in charge, I found the features of the exhibit doubly interesting, by reason of the explanatory information freely given. Among the first questions I propounded was one as to why the Standard Oil Company had made an exhibit, for, although few company names are better known throughout the United States, definite knowledge of the factory methods of this gigantic corporation is exceedingly limited, and there is a prevalent impression that the scrutiny of the public has never been either solicited or desired. The reply was, that when the initial steps for the promotion of the Fair were under way, the Standard Oil Company had been invited to make an exhibit, but had declined. It was then that Mr. Skiff, the gentleman in charge of Mines and Mining, had gone to New York headquarters to present an urgent request for an exhibit, for the benefit of the people of the United States. On this ground the Company had acceded, and the agreement resulted in a magnificent exhibit, strictly educational, and confined, literally, to home resources. Not satisfied with what is here shown, many visitors ask why the oils of Canada, of Russia, of Galicia, or of Japan are not represented, but the careful observer will find that every portion of the valuable oil producing territories of the United States is given the benefit of a graphic exposition. There are many sides to the exhibit, as—geological, historical, mechanical and chemical—and, in each direction, the questions that will be advanced have been anticipated, and those who have time to read the many descriptive labels, and to dovetail one fact into another, will find themselves burdened with a small book of exact knowledge.

To show whence most of the petroleum, to be treated at the Standard Oil Company's refineries, is obtained, there have been prepared two very large profile sections, in relief. One shows the oil and gas producing sands from Olean, N. Y., across Pennsylvania and Ohio, to Massillon; the other shows the same sands and rocks from Massillon, through Mansfield, Findlay and Ottawa, into Indiana, 30 miles west of Fort Wayne. The depths of the oil sands below the earth's surface, and the delimitation of the producing districts, defined by the operations of the drillers, are all clearly shown and fully described; the relative levels of different oil centers, the heights to which oils rise, shown by oils contained in glass tubes, placed at the many towns along the line of the profile, make the system of production very easily understood.

No attempt has here been made to illustrate the process of drilling oil wells, or to explain the tools and machinery used in such work. An outdoor exhibit in the southeast corner of the Exposition grounds shows several derricks for artesian or oil wells; and in a separate building, adjacent to the derricks above referred to, is a very complete model exhibit of derricks, tools, structures of various kinds, and all appliances required for prospecting, or for drilling, piping and pumping in the oil regions.

Contained in large, long glass tubes are earths and rocks, representing, on a reduced scale, actual drillings of productive wells in Ohio, Indiana and Pennsylvania. The adjacent scale affords an easy means of comparison, and the thickness of the many strata and the order of their occurrence have all been carefully reproduced.

How many gas engineers or other persons have ever had an opportunity to view, collectively, specimens of crude petroleum from every State of the Union in which liquid bitumen occurs, or even specimens of petroleums from each important or characteristic well in an individual State? The number cannot be very large; and to those persons whose business or scientific pursuits would make such an opportunity valuable, the many specimens here carefully arranged will prove exceedingly interesting and instructive. The varieties of color, of specific gravity, and of physical characteristics are numerous. The samples are grouped according to their color, the general division being as among black, green and amber or yellow petroleums.

Among the samples of black crude petroleum are some, very heavy,

from California, that from Santa Paula county having a specific gravity of 28.5° Beaume; from Ventura, 18.5°; from Napa county, 15°; and from the Ojai pool No. 1, 14°. This last is one of the heaviest crude oils I have ever seen, and there is much resemblance to tar about it. That there is no relation between color and weight is shown by the following brief list of crude oils, noted at random among the specimen case containing only black petroleums:

Kentucky, Bear Creek.....	23.5°	Indiana, Jay county.....	39.1°
" Barren county ..	28.5°	Texas, Bastrop.....	27.5°
Wyom'g, Rattlesnake Range	19.0°	New York, Allegheny.....	41.7°
" Bighorn.....	29.0°	Illinois, Mongomery county	21.5°
Colorado, Fremont county .	29.0°	Pennsylvania, Butler "	48.0°
Ohio, Monroe county.....	38.5°	" Venango "	48.7°
" Washington county..	43.0°	W. Va., Ritchie county ...	30.0°

This shows a wide range of weight, but, if New York, Pennsylvania, and Ohio are excepted, the general tendency is toward low specific gravities. Many of these are excellent natural lubricating oils; the last on the above list is noticeably good for lubrication, and the only preparation necessary is a preliminary straining to remove rock, earth, and similar foreign matter.

Specimens of green crude petroleums are shown, in abundant variety, from the States of Pennsylvania, New York and West Virginia, the specific gravities averaging higher than those of the black crudes; one from Monongahela county, West Virginia, had a sp. gr. of 48.5°.

Besides the foregoing, there are to be remarked samples of beautiful, clear, amber crudes from Pennsylvania—specific gravity 49.2°—and from West Virginia; also yellow petroleum from Armstrong county, Pa.—48.8°. The systematic arrangement of the specimens, the scrupulous cleanliness of the cases, the clarity of the glass of the containing vessels, and the total absence of any odors, offensive or not, are conditions so favorable to an enjoyable examination that you forget the repugnance so often experienced in "looking upon the oil when it is crude," yet some of these clear amber colored petroleums, and other Kentucky oils, have an odor so offensive and so penetrating as to be nearly unparalleled.

In a small vial, about ¼ inch in diameter and 6 inches in length, and half filled with liquid, is contained a sample of crude petroleum taken from Drake's well, at 69 feet depth, in 1859. This is the first well ever drilled in Pennsylvania. The sample vial is carefully guarded by a stout glass case, and the whole is prominently placed. The contemplation of this tiny portion of dark and dirty liquor in no way suggests the development of an industry which, in the 35 years from the time of its inception, has risen to the rank of third or fourth in importance, according to the classification of the exports from the United States. The great Standard Oil Company must look upon this little sample as a valuable fetich.

The story of the first petroleum well is full of the pluck, enterprise and sound judgment that enabled its promotor and his successors to secure financial success as pioneers in the work. Petroleum, collected from the oil springs at Titusville, in 1854, had been brought to Boston for analysis. The favorable reports led to the formation of the Pennsylvania Rock Oil Company, and then to the foundation of the Seneca Oil Company, in 1857. This latter Company engaged Colonel E. L. Drake to drill at Titusville an artesian well for oil. Titusville was then a small village center for lumbermen. Being 100 miles distant from Erie, the nearest large town, the purchase and transportation of tools were difficult. After an attempt to sink a timbered shaft, by digging, Drake found that water and quicksands made this impossible; it was then that he drove an iron pipe from the surface to the solid rock. This is the first recorded use of a device which has been of immense usefulness in artesian drilling. Then followed a long period when Drake could not secure efficient aid for the prosecuting of the work. After getting the drive pipe down 36 feet, 33 feet of rock was drilled through, and then, August 28, 1859, the drill fell 6 inches into a crevice; on the next day (Sunday) a workman found petroleum in the drill hole, within a few feet of the top. Drake immediately telegraphed to his Company's officials the result of the drilling. Vast areas of land were leased, and abundant supplies of petroleum were profitably procured and sold. In 20 years from the time of the sinking of the first well, 500 wells per month were being drilled, and no less than 150 millions of barrels of petroleum had been taken from the oil fields of Pennsylvania and New York. In 1890 the value of petroleum products exported from the United States was $50,000,000.

Crude and refined oils are transported by barrels, by tank wagons, by tank cars, by steamers and barges, or through pipe lines. There are shown models of tank wagons and of tank cars; these latter hold from 125 to 150 barrels each. When the Union Tank Line was first operated, tank cars and their appurtenances were the chief items of equipment, and it is said that the company did not have a mile of track over which other than their own cars passed. At that time, by mutual agreement between railroad companies, cars discovered to be damaged in transit were repaired by the company last accepting them, without charge to the owners. Under this arrangement the cars of the Union Tank Line were kept in excellent repair, without cost to the company; but finally one of the Eastern railroads found that its large account of expenses for repairs to tank cars was not counterbalanced by any charge of the Union Tank Line, and, learning that that line handled only its own cars, instituted a new system under which hundreds of thousands of dollars were yearly saved to the railway companies other than the Union Tank Line, the saving to others being a new charge to the last named company.

There is shown a good sectional model of a tank steamer for carrying, in bulk, crude or refined oils, or partial cargoes of several grades of oils. This model is of an iron boat, of tonnage measurement, 2,553 tons; tonnage carried, 3,500 tons; the hull, 310 feet long; beam, 40 feet; depth of hold, 28 feet; draught, 22 feet; triple expansion engines; propeller, 75 revolutions per minute; speed, 10 knots per hour, at sea; she has a crew of 35 men, and makes, in a year, 8 round trips to Europe. The model shows the division of the boat into 14 compartments, which can be opened independently, or connected as desired. The total carrying capacity is 1,200,000 gallons, and the vessel can be loaded or unloaded in 7 hours. The tank barges, which are towed about in New York Harbor, or from one seaport to another on the Atlantic Coast, have much lighter draught than the steamers. When it was first proposed to use boats for thus carrying oils, it was feared that the wash of the liquids would be a serious hamper in a sea way, but this obstacle was removed by the introduction of "expansion tanks." These are small iron compartments carried above the level of the deck which roofs in the main oil compartments. Then the oils being loaded so that the level is well up in the expansion tank, the rolling and pitching of the vessel does not affect the stability of the great bulk of the cargo, and only the limited surface of the oils in the expansion tanks is agitated. Hollow iron masts are used, one generally serving the purpose of a lofty chimney, diminishing the danger from the use of fire. Many terrible accidents, explosions and fires, occurred before this system of transporting in bulk had reached a stage of comparative security, and tests of the effect of the sea on the oils carried against the iron hull led to the trial of double bottoms and double hulls. The practice of the merchant mariners engaged in carrying oils from the Russian and Austrian fields furnished the basis of much progressive ship construction. It is probable that to the majority of the consumers of crude and refined petroleums no single item of the gross cost is so large as the expense of transportation; if economies effected here are shared with consumers, the importance of the reduction is obvious.

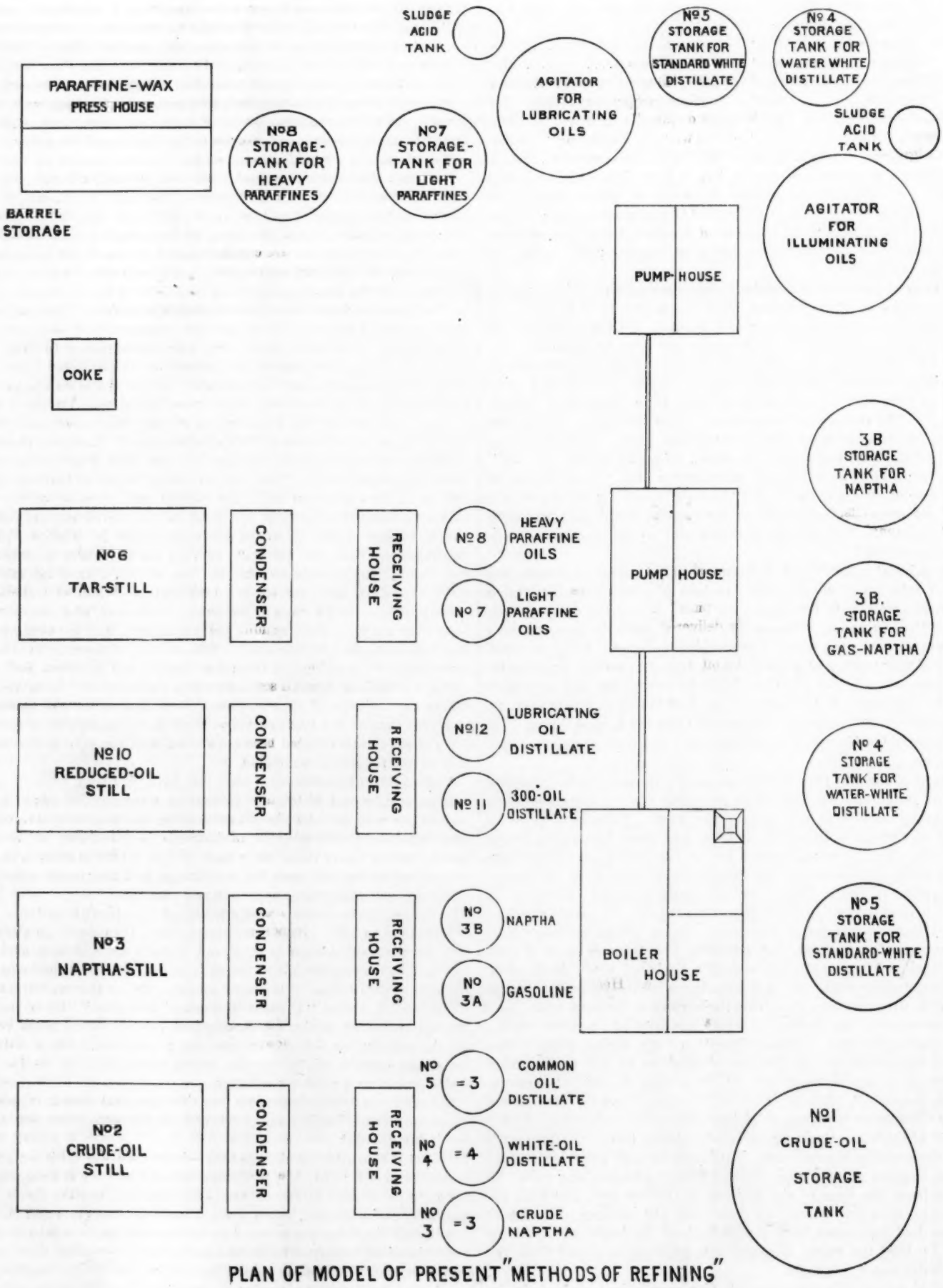
A great deal of petroleum is used just as it is taken from the earth, after separation and filtration. Enormous quantities of crude oil are used in gas making. Crude oils reduced by sunning or by evaporation furnish lubricants for millions of journals in machinery all over the world; but by many times the greater part of all the petroleum pumped is delivered to the refineries for distillation and treatment which will produce illuminating oils, naphthas and paraffines.

In the exhibit is shown a pretty model of the original refinery, built at Cleveland in 1863. Small refineries were then built on a hillside, with the crude oil storage tank placed highest up, and with a general view to distributing the oils to the stills by gravity, and to collecting the products of distillation by the same means. Below this model is an excellent model labeled "Present Methods of Refining." Here the storage and collection tanks are represented by cylindrical glass vessels, and the distributing pipe connections by glass tubes, vessels and tubes containing samples of the liquids which would actually be found at similar points in a working refinery.

This model is not made to scale, but the important steps in the working of the oils are forcibly indicated, and the following succinct description is furnished:*

"No. 1 is the crude oil storage tank—from here the oil is pumped to the crude oil still; No. 2, where it is gradually heated until the naphtha and burning oils are driven off by distillation, and, passing through the condenser and receiving house, are collected in tanks 3, 4 and 5. The burning oil distillates are pumped to the large agitator where they undergo chemical treatment (with acid and alkali) to render them fit for consumption. The crude naphtha is then re-distilled in naphtha still No. 3, giving the various grades of gasolines and naphthas. The tar left after the first distillation is transferred to the tar still, No. 6, where it is separated into light paraffine oil, heavy paraffine oil and still cake,

*See sketch of plan of refinery.



PLAN OF MODEL OF PRESENT "METHODS OF REFINING"

which remains in the still. The light distillate is used for fuel oil. The heavy oil is sent to the paraffine wax press house, where it is chilled and pressed to remove the paraffine oil, leaving the wax. The cake remaining in the still as a final residue is used in the manufacture of electric light and battery carbons. The reduced oil still is used for the production of lubricating oils."

The Standard Oil Company does not make or sell "kerosene." True kerosene is a product of the distillation of coal; it is "coal oil." Shale oil is a variety of the same substance. It is incorrect to designate as kerosene the illuminating oils produced by the distillation of petroleum; these oils are essentially petroleum distillates, or petroleum oils. There is no more common error than to speak of the oils used in house lamps as kerosene, yet it is extremely doubtful whether any kerosene, correctly so designated, is purposely manufactured in the United States. The quality of burning oils differs according to the State or country to which it is sent. The fire test varies from 110° to 150° in the different States; some States specify, by law, the colors of the oils that may be sold for illumination. Oils sent abroad are of a much lower general grade. During distillation, color, weight, temperature and chemical tests, with time and personal experience, govern the distribution of the distillates; the thoroughness of the treatment of the illuminating oils in the agitator determines their final purity and color. In the exhibit are shown samples of the grades of "Standard White" and "Water White" illuminating oils prepared for sale according to the various State laws; nearly every State in the Union is here accorded representation, from Main to Texas, and from New York to Nevada. Large cases are also filled with numerous specimens of special grades of illuminating oils. There is a case containing samples of lubricating oils, varying in color from light pale yellow, through amber, red, green and brown to black; another case contains only cylinder oils of many grades and names.

To return to the distillation of crude petroleum. Besides the refining model already described, this subject is illustrated by a series of cases containing products, duly labeled, showing the result of theoretically perfect fractional distillation in the amounts of crude naphtha, burning oils, tar and coke obtained from a barrel of crude oil. The central feature of the general exhibit is described as "a glass case containing a barrel of crude oil, such as is received from the pipe lines." The average specific gravity of this is not far from 45° B.; more than this amount (one barrel of 42 gallons) is actually delivered from the pipe lines of the Standard Oil Company every second of the 24 hours of every day of the year. The breaking up of the crude oil is in the parts 75, 10, 10 and 5, of burning oils, naphthas, lubricating oils, and tar and cake, respectively. The volumetric representation of the subdivisions is exceedingly interesting and instructive. The per cent. denoting burning oils is exhibited as further separated as follows:

Standard white 150° distillate, representing 29 per cent. of 1 bbl. of crude oil, before treatment with sulphuric acid.

Standard white	120°	distillate,	representing	15 per cent.	of 1 bbl. of, etc.
Headlight.....	175°	"	"	2 do.	do.
Mineral seal...	300°	"	"	1 do.	do.
Water white...	150°	"	"	12 do.	do.
Standard white	110°	"	"	10 do.	do.
Water white...	120°	"	"	3 do.	do.
Water white...	110°	"	"	3 do.	do.

The above list shows how the enactment of State laws, prescribing color and fire tests, enables the intelligent refiner to produce the maximum of the oil locally necessary or desirable. Headlight oil, as its name implies, is used in the headlights of locomotives. Mineral seal is the oil used in lighting passenger railway coaches. If, in an accident, a lighted lamp burning this oil is overturned, the overflow of the oil from the specially constructed reservoir will extinguish the flame and prevent the spread of fire. This oil has a specific gravity of about 36° Beaume. Readers of the AMERICAN GAS LIGHT JOURNAL are familiar with the results (therein published) of the experiments conducted with a view to the conservation and exact determination of the heat developed by its combustion. Besides the above samples showing the distillates before treatment with sulphuric acid and with soda in the agitators, there will be found samples of the same oils, and of intermediate grades, after such treatment and purification. Water white is produced with a little more labor and more care than standard white, but the crucial fire test may be the same for both. The improvement in color is catering to a special trade.

From the 10 per cent. representing crude naphthas is taken 1¼ gallons of light gasoline, and from this, in turn, are obtained redistilled gasolines of gravities 90°, 88°, 87°, 86° and 76° Beaume. Also from the crude naphthas are taken the heavy naphtha distillate, and naphtha still bottoms—left in the still after the distillation is finished. From the heavy distillate come the redistilled naphthas, 58° to 63° Beaume, and the deodorized naphthas, of gravities 61°, 62°, 63°, 67½° to 76°. All of the above mentioned products are illustrated by actual samples.

An entire case is given to specimens of products, in all stages of the manufacture, from the 5 per cent. representing petroleum tar, or residuum, and cake. The heavy distillates from tar are treated with acid, pressed, and yield paraffine oils and crude paraffine wax or crude scale. Samples of these, and of the light distillate, used for fuel, are shown; also samples of hard refined wax, soft refined wax, crude scale, slack wax, zone, red and diamond paraffine oils, foot's oil, gumstock or drippings, pressed oil, and still wax or wax tailings used in the paper trade. Also are shown petroleum cake for electric light carbons, and petroleum pitch or asphalt for paving and roofing. What is known as No. 2 paraffine stock is melted in naphtha on lye, crystallized and repeatedly pressed, yielding small crystals which melt at 116° F., and form the basis of chewing gum—sugar, gum and flavoring extract being the other ingredients. Under the paraffine division should be included vaseline compounds, which are carefully purified and filtered distillates. A large case exhibits petroleum jellies or vaselines, cerates, pomades, soaps and face paints.

The 10 per cent. of the original crude, manufactured into lubricating oils, has no recognizable subdivisions. Wagner states that a pure mineral oil for use as a lubricant must have the proper consistency, must not harden, must not contain any mineral or organic acid, must evaporate and inflame at a high temperature, must show no separation of paraffine under cold, and should have but a faint odor. Paraffine oil that does not boil under 700° F. is considered one of the best of lubricants for cylinders at high temperatures. Mineral oil, carefully prepared, is used for the lubrication of watches. The market affords the purchaser the widest conceivable choice in the selection of lubricating oils; all grades, all prices, colors and names are offered. The admixture of animal and vegetable fats is in the nature of an undesirable adulteration, frequently practiced. There is shown in the exhibit what must be considered as a prize lubricant in a 4 ounce bottle of renown engine oil, which had been in constant use, without loss of lubricating power, for 90 days, on the large Westinghouse dynamo in Machinery Hall. This oil was said to be then as good as new. With reference to lubricating oils, the exhibit of the Vacuum Oil Company, in this same building, and on the same floor with the Standard Oil Company, will be found very interesting. Their works are at Rochester and Olean, and an extensive model, on a small scale, of one works, has been carefully constructed. It looks like "a jumble of buildings, stills and condensers, with hundreds of pumps and miles of pipes." The exhibit of the Dixon Graphite Company, close beside the foregoing, is very handsome, and the growing use of this graphite for lubrication entitles it to a word under the present subject.

As the great bulk of the trade of the Standard Oil Company is in the sale of burning oils, it follows that a lively interest is maintained in the development of satisfactory appliances for the burning of the oil for the production of light. One branch of the exhibit is given to a collection of lamps, ancient and modern; history, art, and nineteenth century commonsense are each given a section of this branch. Old Roman lamps and Jewish lamps recall the days of the first emperors. Those who think that the Florence of Italy is the Paradise of modern times will see a beautiful model of the mediæval Italian lamp placed beside the barbaric souvenir of the Arabs in the form of a Bedouin lamp. There are lamps of the Esquimaux and of the Japanese, showing that these last are not wholly dependent upon the lanterns they have loaned to the rest of the world. There are curiosities in the Flemish hanging lamp, and the Roman horological lamp; the early use of this latter having originated the phrase of "the midnight oil," no doubt. Four large, magnificent, modern lamps, by R Rouis, of New York, are decorative of a small temple, surmounted by a clear statue of paraffine wax, symbolic of light. Other modern lamps and wicks are shown, the make of the Bradley & Hubbard Mfg. Co. There is shown a constant level lamp, such as is supplied for the lighthouse service; in this lamp the light is fed to the wick through a valve in a separate glass chamber at the side of the burner. This replaces the older forms where animal oils were used, when the oil flowed over the wicks. In the new form, refined petroleum oils of high grade, such as Eocene and Pratt's astral oil, give the best results yet attained. In the front of the exhibit is shown a lighthouse lamp of the third order, completely equipped.

Another small temple favorably placed in the exhibit illustrates the development of the crude industry; above this temple is placed a statue of petroleum pitch, representing darkness. In another section is shown a modern candle machine, such as is used in the manufacture of par-

affine candles. This neat, compact and efficient mechanism leaves no trace of the tallow dip of other times.

A leading feature of the exhibit is a cleverly erected pyramid of barrels, at the east side of the section. This pyramid shows the total out put of oil for the United States for one day—140,000 barrels in all. The barrels are so painted that the lines of color effectively aid the eye in the endeavor to compare the several volumes. The total product is thus divided up:

Illuminating oils	105,000 barrels	= 75 per cent.	of total.
Lubricating oils.....	14,000 "	= 10 "	"
Naphtha and fuel oils..	20,300 "	= 14½ "	"
Cake.....	700 "	= ½ "	"

—the several products being indicated by painting the barrels blue and white, red and yellow, purple and white, and black, in the order above given. The statistics which served as a basis for this symbolic representation were obtained from the volume "Mineral Resources of the United States," 1891, compiled under the direction of Dr. David T. Day, of the Division of Mineralogical Statistics of the United States Geological Survey, under the Department of the Interior. Gas men are particularly concerned by such statistics. The amount and quality of the crude or refined oils for use in gas making are inseparable components of the price of the oil, and of the cost of the gas.

A case of sample oils shows distillates used for mixers in painting, in varnishes and japans; also shows moth cloth with naphtha components, and shows the use of naphthas for dissolving rubber. There are samples of deodorized naphthas and of redistilled deodorized gasolines. One application of gasoline is very ingenious. It is used to extract oil from flax by solution, the solution being then highly heated by steam the gasoline is volatilized, leaving the pure flax seed oil of commerce.

In the many windows in the rear of the exhibit are transparencies from photographs taken from the various refineries of the Standard Oil Company. These are so placed that outlines are clearly defined, and the excellence of the work is uniform. Here are shown wagons, cars, tugs, steamers and sailing vessels, all properties of the Standard Oil Company. Among the refineries shown are those of Madison, Bayonne, Philadelphia, Lima, Oil City, Buffalo and Baltimore. Also, the Whiting paraffine works, the Eclipse refinery, the Imperial refinery, Pratt's astral works, the Union refinery, and Long Island City refinery.

There are photographs of pump stations, of maps of oil territories and pipe lines, of United Pipe Line tanks and of well derricks, and one well-colored view of a tank fire. With such a stupendous output of oil, great quantities must be kept in storage in tanks. In fact, from 12,000 to 20,000 more barrels of oil are each day pumped from the wells than are consumed for all purposes, thus the quantity stored must be continually increasing, and new tanks are constantly building to care for this increasing stock. With hundreds of thousands of danger points, oil fires are frequent; not a thunder storm sweeps over the oil regions without leaving a trail of ignited tanks. From other causes, accidents and human carelessness, fires often occur, even at the most carefully conducted refineries. Provision is made for such emergencies. Empty storage tanks are kept in readiness to receive large quantities of oils, and large pumps (16 inch suction sometimes) can quickly draw from the bottom of a tank most of the contents while the surface oil is fiercely burning. Steam pipes of ample capacity are carried to the taps of tanks, and by turning great volumes of steam into the space below the roof and above the oils, fires can often be extinguished and their spread prevented. The heat from a tank of burning oil is terrific. Trained firemen cannot be induced to endure it at close quarters, and the utter uselessness of streams of water as ordinarily thrown from fire nozzles generally invalidates the regular force and apparatus. If the oil fire cannot be extinguished by use of steam, the effort is made to draw the contents from the tank and to prevent the bubbling overflow that marks the burning of crude oil. Cannon balls fired through the sides of the tank lower the level of the burning surface when other means have failed. The total of the fire losses must be tremendous, but it does not affect the prosperity of the Standard Oil Company.

Every gas engineer who visits the World's Columbian Exhibition should see this exhibit; for there is for every man matter of local and of general interest, and a minute inspection will convince him of the value of this rare opportunity for careful observation.

THE Western Gas Construction Company, of Fort Wayne, Ind., has purchased a plot of ground, located south of the yards of the Pittsburgh, Fort Wayne and Chicago Railroad, north of Buchanan street, east of Holton avenue, and west of Oliver street, in Fort Wayne, with the object of constructing substantial shop buildings thereon.

[Prepared for the JOURNAL, by Mr. JAMES M. HADDEN, of the Poughkeepsie (N. Y.) Gas Light Company.]

The "Fixing" of Water Gas.

In the past 18 years, during which I have been continuously engaged in the manufacturing of water gas, I have seen many theories pursued to a conclusion and experiments tried that have resulted in apparatus being built which are almost perfect for the making of the largest quantity of the best quality of water gas. Yet it is surprising to see at this day so many "machines" in use which are not capable of making anything but a very inferior article. The trouble lies almost entirely with the fixing or superheating of the gas after the naphtha vapor has been taken up and held by the water gas.

Everyone who has had any amount of experience with water gas can recall instances where there were appearances of air or carbonic acid when the tests for these would fail to discover either; when the flame would show a dull, bluish shade and yet throw off a large quantity of carbon. The fact was the gas was heavy with carbon, but of such a coarse, lumpy nature that it could not be consumed, albeit it was a gas capable of being cracked, broken and beaten into a far more brilliant illuminant, whose every particle of carbon would add to its brilliancy. In order to do this it is necessary to subject every particle of gas to a large amount of heat, cracking the carbon into finer and finer particles which, uniting with the more calorific water gas, makes it exceedingly brilliant and entirely free from soot.

The most approved superheaters, as I intimated, are not quite perfect. Their defect is a too large diameter. The area of the openings among the brick checkerwork is many times that for either the air while blowing up, or the gas while making a run. In the first place, the flame while blowing up takes the course where the least resistance is offered, and as the nozzle is wide open, with no back pressure to check it, it flies directly out at the open top, heating *directly* about one-third or one-quarter of the brick checkerwork and subsequently the remaining two-thirds or three quarters, and some of it to only a very low degree. Then, when the run begins, the nozzle is covered, and, with a back pressure of anywhere from 10 to 24 inches, the gas is driven into every hole and crevice, and many of them where little or no heat has found its way.

The construction of the checkerwork is wrong, or, rather, it is not exactly right. You may trace the course of the gas. As it first enters the superheater, forced as it is against such a back pressure, it fills every square inch of the area, and in the division some particles reach the outer edges, while those taking the heated center will keep their relative positions, wriggling their way the entire length, whether it be up or down.

We have in use a superheater, 16 feet high; the area is 48 × 36 inches. The gas first passes down through a flue to the bottom of the superheater and to the center of the 48 inches. Beyond this, and opposite the inlet, we have an open space of small dimensions, which acts well as a spark or cinder arrester. From this bottom flue, at the center of superheater, to overcome the errors above mentioned, we so arrange the bricks as to divide, first the flame and then the gases from one side to the other through irregular flues, made by placing the bricks upon their edges about 1¼ inches apart, the course above covering the openings, the amount of gas made per minute determining the number of courses; then a course of bricks, laid flat from one wall to within about 6 or 8 inches of the opposite wall, forming a partition between these flues.

After we had so constructed our superheater a patent was granted for the same thing to Mr. A. M. Sutherland. It will be noticed that at every turn the gases come together and again break and form new relations, and passing through the superheater, greatly increased in length but decreased in diameter, where every square inch is thoroughly heated in the blowing up.

The quality of the bricks is also an item of importance. In lining up the generator the bricks that will best resist the action of the heat are the ones needed, but in the checkerwork of the superheater the conditions are reversed. A brick of a very ordinary quality, one that can be thoroughly and quickly heated through, will give the best results.

I am not in any way advertising Mr. Sutherland's patent, for, as I said, we knew nothing about his or anyone's getting a patent on this construction until after ours was in actual use. What I have said was prompted by the fact that in many places in the country water gas is made and sold where very little or no superheating whatever is done. Improvements can be made on many superheaters now in use without interfering with any patent.

Purification of Coal Gas.

[A paper read by Mr. J. G. Hawkins before the Eastern Counties Gas Managers Association.]

Gas purification may justly be considered one of the most, if not the most, important branches connected with the gas industry. It is of the utmost importance that the gas as supplied to the consumers should be perfectly pure, lest the products resulting from combustion may be such as to vitiate the air and render it injurious to health. The impurities present in crude gas may be enumerated thus: Carbonic acid, ammonia, sulphureted hydrogen, bisulphide of carbon. There are many other impurities, but these need not be considered on the present occasion.

Carbonic acid has the effect of reducing the illuminating power; one per cent. of it reduces the amount of light 6 per cent. Ammonia exerts a corroding influence on brass and copper fittings. Sulphureted hydrogen is perhaps the most obnoxious of all the impurites, chiefly because of its disagreeable odor in case of leakage, and the rapidity with which it tarnishes bright metal, gilt mouldings and silver plate. Bisulphide of carbon, when burning, produces sulphurous acid, which, by exposure to the air, rapidly changes to sulphuric acid, and which, together with any moisture present, is deposited on the furniture, books, mouldings and paintings that may happen to be in the room where the gas is being consumed, having a very deleterious effect. How, then, these impurities may best be removed is what we have to consider.

It may be taken that purification begins at the hydraulic main; but for our purposes we need go no further than the inlet of the condensers. The temperature of the gas at the inlet of the condensers is usually about 130° F., according to the number of retorts at work and their situation. The temperature at the outlet of the condensers should be about 60° F. By this cooling process all tarry and aqueous vapors held in suspension are thrown down as liquid tar and water respectively. It is well known that water in a fine state of division rapidly absorbs ammonia and sulphureted hydrogen, and that ammonia combines with carbonic acid. This being so, it follows that too sudden condensation should be carefully avoided, lest the aqueous vapor is thrown down before it has sufficient time to become charged with those impurities. It is desirable, therefore, that the condensers should in all cases be in proper proportion to the make of gas, and on such a principle as to render too sudden condensation impossible.

The next stage we come to is the scrubber. Why it is called a scrubber I don't know, as that name, to my mind, conveys a very erroneous impression of its real object. There should, however, never be less than two of the so-called scrubbers, no matter how small the works are, the gas passing first through one and then through the other The first should be supplied with a continuous stream of ammoniacal liquor, and the second with a continuous and carefully regulated stream of clean water. The first scrubber will eliminate the bulk of the remaining ammonia, in combination with carbonic acid and sulphureted hydrogen. The second scrubber, being supplied with clean water, will completely remove all remaining traces of ammonia, as well as a small quantity of carbonic acid and sulphureted hydrogen.

We now come to the purifiers proper. The impurities that have to be eliminated at this stage are the remaining traces of carbonic acid, sulphureted hydrogen and bisulphide of carbon. In towns where the gas authorities are not compelled by Act of Parliament to remove sulphur compounds other than sulphureted hydrogen, the elimination of the bisulphide of carbon is not of importance; and in those cases oxide of iron alone might be used. But where the authorities are compelled to keep the sulphur compounds within prescribed limits, the removal of the bisulphide of carbon is essential; and this necessitates the employment of lime. Some engineers prefer to use both lime and oxide—placing the lime first, with the object of removing the carbonic acid and the bisulphide of carbon; and oxide last, for arresting any traces of sulphureted hydrogen. Others, doubtless on account of economy, are content to use oxide of iron only, and in such cases, of course, sulphureted hydrogen is the only impurity dealt with. I have found that the best way to use oxide of iron is in layers of 1 foot 6 inches deep, two layers in each purifier. I have purified more than 100,000,000 cubic feet of gas with one single change of purifier when using oxide of iron. The oxide was new when put into the purifier, and when taken out it contained 50 per cent. of free sulphur. These results were obtained with the atmospheric air process, introduced by myself some few years ago, and which I explained in a paper I read at a meeting of the Manchester District Institution of Gas Engineers. The process is continuous, and offers great advantages where oxide alone is employed.

At the Spalding gas works, of which I am manager, I have recently been making some experiments with regard to gas purification with lime. Those experiments are as yet far from complete; and as a consequence I am unable at this meeting to give you all the information I should like respecting it. Our annual make of gas is 22,000,000 cubic feet; and our purifying plant consists of 4 purifiers 8 feet square by 3 feet deep. Previous to the commencement of my experiment, it was usual to change three purifiers every fortnight in the winter, and an average of two every three weeks during the summer. I commenced my experiment on the 10th of May (just four months ago), when I had the usual two foul purifiers and one clean one. I began by introducing a carefully regulated quantity of atmospheric air into gas at the inlet of the condensers, amounting to 2 per cent. Two days later I found that I had only one foul purifier and two clean ones; and for a week we remained stationary in that position. I then increased the atmospheric air to 2½ per cent., with the result that two days afterwards I had no foul purifiers whatever. We continued in this position for a whole week, carefully noting the quality of the gas the whole time. I then shut off the supply of air; and within a few hours the first purifiers showed traces of sulphureted hydrogen. In three days it had got decidedly foul; and the No. 2 purifier also showed traces. I then reintroduced the air as before; with exactly the same result, which I have repeated many times since. At the present moment all our purifiers are clean—not one of them showing the slightest trace of sulphureted hydrogen.

The quantity of gas made from the commencement of the experiment up to now is 4,208,000 cubic feet; and during this time there has been no change of purifier whatever, and the purifiers that were foul at the beginning are now clean. The illuminating power of our gas is about 17 candles, which has, if anything been slightly improved during the experiment; and our make of gas per ton of coal will average close upon 11,000 cubic feet.

Thinking it would be of interest to the meeting if I extracted a sample of the material from the first purifier, I have just had that purifier shut off, and a sample taken therefrom. On analysis, it will be found to contain 29 per cent. of free sulphur. It is perfectly inodorous; showing clearly, therefore, that it has a considerable commercial value, and must no longer be looked upon as waste, nor to become a nuisance. I have also brought with me a sample of sulphur obtained from 100 grains of the material taken from the sample now before you.

In working upon this system, great care must be taken to keep the percentage of air constant, and in regular proportion to the make of gas. As the make of gas varies, so must the quantity of air vary accordingly. This can only be accomplished by some suitable contrivance working in combination with the station meter. Such an arrangement is in operation at the Spalding gas works, where it may be inspected by any members who choose to do so.

My experience of lime and oxide purification up to the present is decidedly in favor of the former; it being, in my opinion, the better purifying agent of the two, and more economical.

Discussion.

Mr. T. Greaves (Melton Mowbray) said he had had 16 years' experience of working with oxide, and he quite agreed with the author of the paper that lime should be used in the last purifier. It was more economical than using lime entirely, and in its results it was quite equal to lime purification. He has been admitting air to the purifiers for more than three years, and he had used as much as 3½ per cent. without in the slightest degree deteriorating the illuminating power of the gas. He did not send out gas of lower quality than 18 candles. That day it was 20 candles, and sometimes it was as high as 22 candles. As Mr. Hawkins had said, it required a good deal of experience and good management to enable one to gauge the quantity of air to the quantity of gas passing. If properly looked after, the air did not deteriorate the gas. Reverting to the oxide and lime mode of purifying, he said that since the 6th of May he had made nearly 6,000,000 cubic feet of gas, and he had not changed his purifiers; and he did not think that they would require to changed before the end of October.

Mr. F. Weller (Southtown, Yarmouth) said he had three purifiers, 8 feet by 4 feet deep, and he used four layers of lime. He would like to know how the air was to be regulated to the quantity of gas passing. Of course, there was a good deal of labor connected with changing purifiers, and if the use of oxide would reduce that labor he would adopt it. The quantity of sulphur which the lime took up varied with the coal used, as well as with the quality of the lime. There was a great difference in the quality of both of these materials.

Mr. John Barton (Peterborough) said the subject treated by the author of the paper was well worth the consideration of all gas managers. He

had had the air process at his works for over 12 months. He did not care to draw in the air by the exhauster, as he felt that something might go wrong; so he had special machinery prepared, and special plant put down for drawing in the air. He had found that by the adoption of this process he had derived great benefit, without producing any injurious effect on the illuminating power of the gas. He had during the period referred to used pretty much the same quality of coal as he had done previously, and he had not the slightest difficulty in keeping the illuminating power at 17 candles, and something more during the summer months. But he did not admit so much air as Mr. Greaves; he tried to keep it uniformly at 2 per cent. of the quantity of gas being made. It was, in his view, very important that uniformity should be maintained. If too much air were allowed to enter the purifiers, harm rather than good would be done; but if the right percentage was maintained, good was done and not harm. He worked two boxes of oxide and one box partly filled with oxide and partly with lime—the lime being in the top part. The difficulty he experienced was not so much that of keeping the purifiers clean as getting rid of back pressure. He did not know how he would get on if he had 3 or 4 feet of oxide. He used not more than 18 inches, and sometimes that was reduced to 16 inches, in order to get the purifiers to do the work he expected them to do. He had to change them, not because they were foul, but on account of back pressure. The present purifier had passed 25,000,000 cubic feet, and it was perfectly clean; but the pressure was beginning to increase, and he feared he would have to change it before the oxide was thoroughly saturated. He would be glad if he could get over that difficulty. If some scheme could be arranged to adjust the percentage of air he thought that gas purification would be nearly perfect. No doubt the bisulphide could not be taken out by iron, but oxide and lime would do the work.

Mr. A. Drage (East Dereham) narrated his experience of oxide. He found that the oxide on the bottom tier got hard, while the other three tiers were not touched, and this threw great pressure on the exhauster.

Mr. Wm. Barratt (Grantham) said that the paper was a suggestive one; but the subject was surrounded by incidents which had not been touched, and which it was essential to know about, such as condensation, scrubbing, and the state of the gas before it reached the purifiers. If they had condensers and scrubbers that were not doing their work, the gas, when it entered the purifiers, must be in a different state than when the appliances referred to were doing their duty properly. Therefore they must know that the scrubbers, condensers and purifiers were in order before they could arrive at a just conclusion. He did not use oxide at all. He thought it would have been well had Mr. Hawkins worked out the cost of purification with oxide of iron and lime. He might say he got a fair price for his spent lime. Perhaps Mr. Barton could not get good lime, and could not get a ready market for it after it was fouled, and in such circumstances it might be cheaper to use oxide and lime. He could not understand the use of lime first and oxide last. He always understood that the reverse of this was the proper way to work. Mr. Hawkins would require to explain this. He was of opinion that condensation and scrubbing had a great deal to do with purification—a great deal more than it got credit for. When he went to Grantham he had more condensing power than he wanted (five double condensers), and he had no means of checking it, so he took off the top plate and introduced a 2-inch pipe from the top to the bottom, and secured it to the flanges. Then he found that this altered his condensers to such an extent that the difficulty he had experienced was removed. By this simple contrivance he brought down his condensing account by about 40 per cent.

Mr. Barton said he would like to supplement his remarks regarding cost by saying that it was about 0.030d. per 1,000 cubic cubic feet sold.

Mr. John Carter (Lincoln) said that there was a great deal in the paper, which they might profitably read a second time. One observation he did not quite agree with. He understood Mr. Hawkins to say, with reference to the renewal of the sulphur compounds other than sulphureted hydrogen, that in those places where there were no statutory restrictions the question was not one of importance. He would take a broader view of the subject. He thought it was of great importance, even if a company were not restricted to a certain number of grains per 100 cubic feet. It was extremely necessary that the manager should keep down the sulphur compounds to as low a point as possible. With reference to the use of oxide of iron, his experience had taught him that the excessive use of oxide, even with provision for the admission of atmospheric air, was not a satisfactory method of purification. The figures given by Mr. Barton were suggestive. It was satisfactory to learn that gas could be purified at a cost of 0.030d. per 1,000 cubic feet of gas sold. He should not like to show his figures side by side with those of Mr. Barton. To keep down the sulphur compounds to 14 or 15 grains he wanted something near ¼d. per 1,000 cubic feet made. He had discontinued the use of oxide. When in the spent condition it could be sold at 4d. and 5d. per unit, there was more inducement to use it than when it fetched 2d. per unit. But in discarding oxide and reverting to lime there was the difficulty to face of keeping a large quantity of foul material on the works. He was thankful to Mr. Hawkins for the paper, because it reminded him of the value of using lime, which he believed to be the best material to use in the purifiers, and which could be rendered inodorous by the admission of a small percentage of air. After what had been said he thought he might try his hand at the process.

Mr. Hawkins, in reply, said he quite agreed with Mr. Greaves that if they introduced a sufficient quantity of air, as that gentleman had done, they might increase the thickness of the purifying material; but in taking the ordinary run of working 18 inches would be sufficient. He did not mean to say that if the purifiers were of large dimensions he would not increase that thickness; it would make the material last longer. The great thing they had to contend against was back pressure. Until the purifiers showed traces of sulphureted hydrogen the manager would not turn them off unless the pressure was greater than he could possibly work with. Mr. Weller was anxious to know whether anything could be done to adjust the quantity of air to the quantity of gas passing. In answer to that inquiry he might say that he had a mechanical arrangement which effected this object. The mechanism which performed this work was coupled to the drum spindle of the station meter. A wheel worked into the first wheel of the station meter drum shaft, and to that there was a counter shaft coupled to a 30 light wet meter; so that at whatever speed the station meter went, this 30 light meter, being set to a certain ratio of revolution, must work in accordance with the station meter. It would be seen that this arrangement could be adapted to any proportion of air to the quantity of gas passing. If he wanted more than, say, 4 per cent. of air, all he had to do was to increase the dimensions of the driving wheel. No system of air purification could be perfect unless it was worked in this way. It would not do to have such irregularities as 5 per cent. of air at one time and 2 per cent. at another. The supply of air required to be continuous, and in the exact ratio which he had mentioned to the make of gas. The observations of Mr. Barton as to pressure were quite correct. If the purifiers were large they could, of course, work for a much longer period. Mr. Drage said that he had found that the bottom layer of his oxide of iron purifier got hard, whilst the top layers showed no traces of sulphureted hydrogen. He would suggest to Mr. Drage that if he put a thin layer of breeze beneath the bottom layer of oxide it would absorb all the moisture which was entering the purifier, and it would prevent the clogging of the oxide at the bottom of the purifier. With respect to the question of cost, he contended that he had done his purifying for nothing, and for this reason: At the commencement of the experiment referred to in his paper he took two purifiers, and they were still clean. Of course, they would not last forever; the time would come when they would require to be changed, and that would be when the oxide was fully saturated with sulphur. No doubt, as Mr. Barratt had said, the condensing and scrubbing powers should be fully equal to the occasion.

Mr. Greaves said he should like to get some explanation on the point why the oxide got hard. When he first commenced to work with oxide, he was under the same difficulty as Mr. Drage. But from experiment and observation he found that the amount of moisture in the oxide made all the difference. If they had too much moisture in the oxide it would become hard; but in the way in which he now worked the bottom tier was no harder than the top tier—that was to say, they were practically equal. He maintained that the moisture in the oxide accounted for this difference, when there was a difference. He asserted that the purification of his gas had cost him nothing; indeed, he was sure he had made a profit upon it. The additional weight of oxide coming from the purifiers had more than repaid the original cost of the pure oxide. One ton of new oxide would make 2 tons 10 cwt. before it was fully saturated, and for the saturated material he could obtain from 27s. to 32s. per ton.

Mr. Hawkins said that in dealing with lime they must consider the same point. The spent lime was worth money, because it contained 29 per cent. of free sulphur, and that at 4d. per unit would be worth from 12s. to 14s. per ton.

Mr. Jones said that the points in the interesting paper by Mr. Hawkins had been pretty well threshed out, and little remained for him to say. The paper confined itself to certain points in purification, which certain of the speakers had enlarged upon. There could be no doubt whatever of the necessity of having the condensing and scrubbing apparatus in proportion to the purifiers. One point, however, it appeared

to him, had been lost sight of, and that was the velocity with which gas traveled through the material. This purifying material must be more or less dense. The lighter it was the more easy would it be for the gas to pass through it, and the denser the more would be the back pressure, and the greater, therefore, the difficulty of forcing the gas through it. It necessarily followed, therefore, that if they took a large area they could pass the gas through at a low velocity. If they halved that area, then the faster would the gas have to travel. The broad question, which was not raised in the paper, as it might have been, was that relating to areas, and ought to have received more attention than it had got. It was by long continued contact that the impurities they desired to eliminate were got rid of. Purification commenced at the hydraulic main, and it was continuous until the purifier was reached; indeed, the purifier was simply the finisher—it acted, as it were, like the French polisher. The subject of the paper was one of considerable interest to everyone. How little was known of the wonderful changes that took place in purifying vessels! They tried to reason and to know, but at the present moment no one exactly knew what took place in these vessels. He hoped the time would come when they would know more. It was only by the introduction of such papers and their discussion, and by the interchange of views of gentlemen who had practical experience and theoretical knowledge, that they could possibly arrive at some definite point.

Gas Consumption.

[From "Series of Articles for Gas Students" in the London *Journal*.]

The subject of the present article is a very comprehensive one. It embraces the design and construction of various types of gas-utilizing appliances for illuminating, heating, and for general trade purposes; also pressure regulators, globes, shades, fittings, and other appendages designed to aid in the economical development of the highest available duty of the gas; and—as essential to a thorough apprehension of the principles which should underlie the construction of the foregoing—a careful study of the average composition of ordinary illuminating gas, of the characteristic properties of its principle constituents, of the structure of flame, and of the conditions necessary to the perfect combustion of the gas. It will therefore be more convenient to divide the article into sections, and to discuss the various subjects enumerated under the following heads: Composition of ordinary coal gas, and the structure of flame; conditions favorable to perfect combustion and the development of the highest available duty, and the application of same to burner construction; various types of gas burners, illuminating and otherwise; pressure regulators, fittings, etc.

1. *Composition of Ordinary Coal Gas, and the Structure of Flame.*

The student is by now fairly familiar with the principle constituents of ordinary illuminating gas, and their normal effect on its luminiferous value; but he must remember that the approximate percentage composition is not always a safe indication of the capabilities of a gas. On the contrary, the degree of permanency of some of the light-giving hydrocarbons is largely affected by certain circumstances attendant upon the manufacture of the gas—such as the temperature of distillation, the duration of the period of carbonization, the methods of enriching (if any), and also upon the condensing arrangements, and other variable conditions which may or may not be beyond control. The recently introduced methods of enriching coal gas with rich oil gases, has much intensified this difficulty; and herein probably lies the principal explanation of that marked diversity in photometrical results which has repeatedly been observed when testing gas from the same works, and presumably of fairly constant composition. Another even more frequent phenomenon is an actual variation in the composition of the gas itself when produced from the same class of coal, and presumably under precisely similar working conditions. A little neglect on the part of the stokers—either by delaying a "draw" somewhat, and thus leaving a charge too long in the retort, or through charging "light" to similarly cause a charge to remain after being thoroughly spent—is apt to alter the constitution of the gas very materially, by splitting up certain hydrocarbons, with the formation of others of a different nature. Similar variations may attend undue heating of a bed, over charging and all or any of the thousand and-one errors of judgment incident to the workings of the retort house. Rapid, inefficient, or excessive condensation is also likely to produce undesirable complications of a like nature—as already pointed out.

Curiously enough, these variations are not *necessarily* attended by corresponding alterations in the illuminating power, although the gas when under test will probably require slightly different conditions of pressure and air supply. It has also been noted that various samples of gas taken from bulk, will not, under precisely similar conditions, always give exactly the same photometric results. In a previous article will be found the percentage composition of a sample of London gas analyzed by Professor Vivian B. Lewes, as also tables of the principal constituents of ordinary coal gas and their light-giving values. The following is another analysis by the same authority:

	Per Cent.
Hydrogen	51.6
Marsh gas	36.7
Illuminants	5.8
Carbonic oxide	5.1
Carbon dioxide	0.0
Nitrogen	0.6
Oxygen	0.2
	100.00

The following analysis of London cannel gas is from the "Chemistry of Illuminating Gas," which every student of gas matters should carefully study:

	Per Cent.
Hydrogen	29.7
Marsh gas	50.0
Illuminants	13.0
Carbonic oxide	6.8
Carbon dioxide	0.1
Nitrogen	0.4
Oxygen	0.0
	100.0
Water vapor	2.0

Taking an average sample of coal gas, it will be found to consist, roughly, of 50 per cent. (or one-half by volume) of hydrogen gas, 35 per cent. (or over one third) of marsh gas, and about 5 per cent. (or one-twentieth) of carbonic oxide, all three of which are practically non-illuminating (although the marsh gas, under circumstances already noted, may indirectly assist in the production of light.) The luminosity of the gas is therefore derived solely from some 5.5 to 6 per cent. of illuminating hydrocarbons—ethylene, acetylene, benzine, etc.—which are thus diluted in the bulk of the gas by some 93 per cent. of non-illuminants. Of these diluents, the three first named play an important part in the combustion of the gas, and (indirectly) in the development of light from the illuminating series of hydrocarbons. The nitrogen takes no part in the combustion, and tends to cool the flame and lower its luminosity. To a certain extent, the presence of oxygen is favorable to the development of light.

Hydrogen is well known to the student. It is of the lightest specific gravity of any gas (hence it is taken as unity), burns with a blue flame of intense heat—the product being water vapor—Marsh gas (light carbureted hydrogen CH_4) burns in excess of air with a bluish-yellow non-luminous flame, producing simply carbon dioxide and water; but when burnt with a limited supply of air, it yields several products, amongst which is acetylene, C_2H_2. The peculiar smell which attends the incomplete combustion of coal gas, as when "lighted back" at the jet of a Bunsen burner, is due to the formation of acetylene. Carbonic oxide burns with a blue flame of very intense heat—the product being carbon dioxide. This latter gas, passing through the incandescent carbon (noted later on), takes up another atom of carbon, thus again being converted into carbon monoxide, which is once more oxidized, with the formation of carbonic acid. The ignition point of hydrogen gas is comparatively low—a dull red heat being sufficient to fire it. That of marsh gas is, on the contrary, very high; while carbonic oxide also ignites at a low temperature, slightly above that of hydrogen. Hence, when (say) a lighted taper is presented to a stream of gas issuing from an ordinary burner, the heat of the taper light at once ignites the hydrogen of the gas, and also the carbonic oxide. The heat attending the combustion of these two gases is sufficient to decompose the hydrocarbons into their elements—hydrogen and carbon. The former, having greater affinity for oxygen than the latter, is readily oxidized—intense heat being thereby generated. The heat thus produced by the combustion of the hydrogen—both that originally free and also that just liberated—is sufficient to raise the particles of carbon (which have been liberated in the solid state, by the aforesaid decomposition of the hydrocarbons) into incandescence, in which condition they continue until, passing through the flame, they approach the outer zone of combustion, where meeting with an excess of oxygen they are converted into carbonic acid. This will be more apparent as we consider what is the structure of an ordinary gas flame.

A gas flame is either luminous or non-luminous. In either case we have present what may be termed three distinct zones, or areas of combustion. First, there is nearest the burner and to a little distance from it, a dark central zone of unburnt gas, which is, however, inclosed within an envelope of the non-luminous blue flame of burning hydrogen, and possibly of carbonic oxide also. This zone of unburnt gas is attributable to the absence of heat at this point of the flame—due primarily to the cooling effect on the flame of the gas as it issues from the burner tip, as well as to abstraction of heat by the burner itself. The presence of this unburnt gas, as also of the non-luminous flame, may be proved (1) by inserting an open tube into the flame at this point, when the gas will pass along it from the center of the zone, and may be ignited at the far end; and (2) by placing a platinum wire through this portion of the flame.

Next comes the luminous zone, or area of incomplete combustion—the latter condition being due to the limited supply of air which necessarily obtains at this point. This zone, or belt, is also opaque (being itself capable of casting a shadow), which is indicative of the presence of solid matter. The origin of the latter has already been explained, and is due to the decomposition, by the heat of the burning hydrogen, of the hydrocarbons into their constituent elements, carbon and hydrogen. The gaseous hydrogen burns directly. The solid particles of carbon—the presence of which may be readily ascertained by inserting a cool surface into this part of the flame, which surface is immediately blackened by particles of soot or pure carbon—are raised to incandescence by the intense heat, and impart to this zone its characteristic intense luminosity. In the bunsen flame, this middle zone is non luminous, the reason for which is explained in a succeeding paragraph.

Outside all is the non-luminous zone, or area of so called complete combustion. With the luminous flame, this zone is practically invisible; but it is readily discernible in the bunsen flame. It is largely due to the combustion of carbonic oxide gas. The supply of air to the middle zone being but limited, the oxidation of the carbon is incomplete, and carbonic oxide (CO), as well as carbonic acid (CO_2), is largely produced; whilst in the outer zone of unlimited oxidation, the bulk of the former is converted into the latter.

Professor Lewes suggests, however, that even here combustion is not perfect. He says: "It is a zone in which luminosity is destroyed in exactly the same way that it is destroyed in the bunsen burner—*i. e.*, the air penetrating the flame so dilutes and cools down the outer layer of incandescent gas, that it is rendered non-luminous; while some of the gas sinks below the point at which it is capable of burning, with the result that considerable quantities of the products of incomplete combustion (carbon monoxide and acetylene) escape into the air, and render it actively injurious." The Professor's remarks are supported by an examination of certain gases which, escaping from this outer zone, had been carefully withdrawn by aspiration and analyzed, with the following results:

Gases Escaping from the Outer Zone of Flame.

	Luminous.	Bunsen.
Nitrogen	76.612	80.242
Water vapor	14.702	13.345
Carbon dioxide	2.201	4.966
Carbon monoxide	1.189	0.006
Oxygen	2.300	1.430
Marsh gas	0.572	0.003
Hydrogen	2.388	0.008
Acetylene	0.036	—
	100.000	100.000

Another very interesting table as illustrative of the order of combustion of the various constituents of coal gas, and based on the experiments of Landolt upon a rich coal gas flame, is the following:

Composition of Gas in Flames at Varying Heights from the Burner.

Composition of Gas in Flame.	Height from Burner in Inches. 0	0.39	0.79	1.18	1.58	1.97
Hydrogen	22.66	14.95	15.49	15.54	14.50	11.95
Marsh gas	33.77	30.20	28.34	21.55	11.92	3.64
Carbon monoxide	7.34	14.07	14.05	14.58	22.24	25.14
Olefines	7.29	7.49	7.87	7.94	7.05	5.45
Oxygen	0.66	0.78	0.47	—	—	—
Nitrogen	29.41	38.66	140.78	184.23	270.45	307.10
Carbon dioxide	1.94	2.34	10.11	14.98	23.76	32.34
Water	8.34	11.60	38.85	52.55	72.67	75.61

The chemical changes comprised in the combustion of an ordinary gas flame may be expressed in symbols thus:

2H	+	O	=	H_2O		
CH_4 (marsh gas)	+	4O	=	$2H_2O$	+	CO_2
CO	+	O	=	CO_2		
C_2H_4 (olefiant gas)	+	6O	=	$2H_2O$	+	$2CO_2$

The ordinary form of a bunsen burner is well known. The gas supply is caused to pass through a jet in a fine stream, into an open tube or chamber to which air has free admission. Passing upwards towards the burner orifice, the gas draws with it currents of air, with which it intimately mixes before reaching the point of combustion. The proportions of air and gas can be adjusted according to the pressure of gas and the relative proportional areas of the gas and air inlets into the mixing chamber.

The perfect and intimate mixture of the gas and air is provided for in the calculation of the cubical area of the mixing chamber; whilst due attention is also given to the total combined area of the burner orifices, in relation to the combined areas of the air and gas inlets. There is no luminosity in the Bunsen flame; and the cause of this is at least twofold. In the first case, there are no solid particles present in this flame, as in an illuminating flame; and hence there is no incandescence. This appears to be due to the direct and simultaneous combustion of the hydrocarbons without any prior decomposition, and consequent liberation of carbon particles. The reason for this direct oxidation of the carbon and hydrogen is much disputed; but it is doubtless principally due to the diluting effect of the inert nitrogen present, and also probably to the intimate presence of oxygen in the midst of the flame. Gases so diluted cannot be raised to a temperature sufficient to cause decomposition and subsequent incandescence. The middle zone is, as already stated, one of incomplete combustion, but not to such an extent as with the luminous flame. There is no doubt that the cooling effect of the air present in the midst of the flame, and more particularly the inert nitrogen—is partly accountable for the absence of luminosity, as, if by any means the mixture can be strongly heated just prior to combustion, a distinctly luminous flame is at once produced. A similar effect results in the addition of a limited supply of oxygen, which immediately raises the temperature, and with it the luminosity, of the flame. This proves that the absence of light cannot be simply due to the rapid oxidation of the hydrocarbons. Lastly, an increase of atmospheric pressure will tend to increase the luminosity of the flame.

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

On the 6th inst. the Hon. M. Rumsey Miller, of Bath, N. Y., will sit at Elmira, N. Y., for the purpose of taking testimony in the instance of the proposition to dissolve the Elmira Gas and Illuminating Companies.

The Norwegian ship Breidablik recently arrived at San Francisco, from Glasgow, Scotland, 133 days out, loaded with bituminous coal. Fire had developed in her cargo, and the danger was only averted after much arduous work.

The Directors of the Clarksville (Tenn.) Gas Light Company have authorized the Secretary (Mr. Thomas Bourne) to issue the following notice to the residents of the place: "All gas consumed from October 1, 1893, will be charged for at the following rates: Over 5,000 cubic feet per month, $2 per 1,000 net; over 3,000 cubic feet and under 5,000 cubic feet per month, $2.75 per 1,000, with 10 per cent. off; over 1,000 and under 3,000 cubic feet per month, $2.75 per 1,000, with 5 per cent. off; over 500 and under 1,000 cubic feet per month, $2.75 per 1,000 net; under 500 feet per month, $3 per 1,000 net. Gas bills must be paid by the 10th of the month, or no discount will be allowed. Arrearages for gas bills must be paid up before consumers can receive the benefit of this new schedule of rates. The Company also informs its patrons that any complaint of gas not burning properly, either from the fault of bad burners or any other defect causing an unsatisfactory light, shall have prompt attention and the trouble remedied as soon as practicable. Consumers should always bear this in mind and not suffer from a poor and inferior light. Burners clogged with dust and dirt cannot be expected to give a satisfactory light. Such burners will be cleaned and new tips furnished free of charge if the consumers will notify the Superintendent."

Mr. T. G. Lansden is confined to the house, suffering from an affection of the eyes. It is, however, with great satisfaction we add that his complete recovery is only a question of a few days.

Col. John Dell was seen in the house furnishing goods mart of St. Louis some days ago, chiefly directing his inquiries to those who sold cribs, cradles, and so on. The new arrival is a boy, and he weighed a

trifle over 9 lbs. He has blonde hair and good lung power; and everybody is well and happy.

ON October 1st the proprietors of the Hoosick Falls (N. Y.) Gas Light Company ordered a reduction in the gas rate from $2 to $1.75 per 1,000 cubic feet.

PHILADELPHIA capitalists have purchased a controlling interest in the Citizens Gas Light Company, of Tamaqua, Pa.

AT the annual meeting of the Lewiston (Me.) Gas Light Company, the following officers were elected: Directors, Wallace H. White, Seth M. Carter, Edward C. Lee, Samuel T. Bodine and Randal Morgan; Treasurer, Edward C. Lee; Clerk, William R. Stevens. The main system, when the extensions now underway shall have been completed, will show an increase of 7 miles for the year 1893.

ABOUT a month ago President John F. Budky, of the Canonsburg Fuel and Light Company (natural gas), issued a circular notifying the patrons of the Company that they would be required to use meters on and after September 15th. Meters could be purchased at the office of the Company by paying down $7, and the balance ($8) in one year with interest. The consumers were notified that unless they had meters on the date specified, the gas would be turned off. Many failed to obtain the meters, believing the order would not be carried out, but on Saturday, September 16, the employees began shutting off the gas from those who had not purchased the meters. About 200 families are concerned, and, as it is easy to understand, the people are very indignant.

THE Huntington (L. I.) gas works are completed, and the house connections are being made.

SOME time ago it was asserted that Mr. E. W. Hamlin, of Cincinnati, Ohio, the principal owner of the gas works at Wilmington, Ohio, had determined to shut down the Wilmington Gas Works, because it was impossible to maintain the same on a paying basis, owing to the low rates charged for an incandescent electric lighting service, which service is carried on by the municipality from the electric plant installed there some time ago on public account. The situation as it stands, is well summed up in the following letter, written to a resident of Wilmington by a gentleman now living in Columbus, Ohio. The writter, it might be further said, is well versed in the conditions existing at Wilmington: "I have your letter of yesterday stating that Mr. Hamlin announces that he will shut down his gas works on November first. My acquaintance with Mr. Hamlin leads me to believe that he will do as he says. In this case he will be doing what any other sensible gas works owner would do under the circumstances—shut down his works rather than operate them at a loss in trying to compete with the ridiculously low prices which your town authorities have fixed for private arc and incandescent electric lights—for the town of Wilmington has simply wrecked its gas company by the inadequate rates at which it furnishes electric lights to private consumers. If the town must needs have gone into the private lighting business (the justification for which would be a difficult matter to establish under any circumstances), it should at least charge enough for such private lighting to cover the cost of furnishing the same, including the additional operating expenses, interest on the additional investments thus made necessary, the increased depreciation of the plant (which is enormous in electric light works, and is seldom figured as high as it should be), the cost of making out and collecting the bills, the extra supervision and management which the private lighting necessitates, etc. Thirty-five cents per month for each incandescent light, and $5 per month for two arc lights will not bring in nearly enough money in your town to pay the cost of furnishing them, if the cost is properly calculated. If the prices had been sufficiently high to cover the real cost, as they should have been, the Gas Company would not now be ruined as it is. For in fair and business-like competitions, gas light is much cheaper than electric light for private illumination, and practically all of your citizens who were using gas would have retained it, thus making enough business to justify the continued operation of the gas works. As it is, your taxpayers (including the gas works, undoubtedly one of your largest), are being heavily taxed to furnish electric lights to private consumers at less than actual cost. Why don't the town tax the property owners to buy coal and then sell it below cost to everybody who wants it, non-taxpayers included? for the heating of houses and stores is just as much a public business as is the lighting of them. This would be just as consistent, and just as good political economy. Your taxpayers who do not use the electric lights, including the Gas Company (who cannot move its property from your town, nor afford to operate it where it is) are making up the deficit incurred by your furnishing them at a loss to their neighbors, who may or may not be taxpayers. Whether they are or not, the injustice is obvious. Put up the price of your commercial and domestic electric lights to at least a cost basis, as you should do in all fairness to the great mass of your taxpayers who do not use them, including the Gas Company, who brought your town thousands of dollars of capital, and the Gas Company will then be able to resume business and supply your citizens with light, and with fuel for cooking, at all times and at a reasonable price. Your people must not infer, because their Gas Company goes to the wall under existing circumstances, that gas is unable to hold its own against electricity. When both are put on a paying basis, gas can successfully compete with electricity and is doing so to-day all over the country. Statistics show that the quantity of artificial gas consumed in the United States during the past year was 10 per cent. more than was used during the preceding year, notwithstanding electricity has been in the field for 15 years and is now firmly established. I predict that within 5 years, if they are not already beginning to realize it, your taxpayers will be very much surprised and dismayed to find what the luxury of electric lights on their streets is costing them, even if they adopt the wisest management. They should not add unnecessarily to the burden by furnishing private lights at less than cost."

THE proprietors of the Malden and Melrose (Mass.) Gas Light Company have ordered that a reduction of 20 cents per 1,000 cubic feet in the selling rate be made, the same to take effect on January 1, 1894. Under this practice the net rate will be $1.60 per 1,000 cubic feet.

MR. ROBERT FAULKNER, formerly an employee of the Hudson (N.Y.) Gas Light Company, died at his home in Boston about a fortnight ago. He was in his 61st year.

UNDER the new scheme planned for the placing of public electric lights in Seattle, Wash., there will be 218 arcs and 550 incandescents. The incandescents heretofore in use numbered 900. The incandescent electric lamp as a street illuminator is a failure.

THE Selectmen of West Springfield, Mass., recently granted a franchise for the operation of a gas works at that point to the promoters of the Mutual Gas Light Company, the backers of which, it is said, are residents of this city. At any rate, Mr. George Olney is one of those interested, and he probably will be remembered by many of the gas men of this section. According to the information we have, the Company is capitalized in the sum of $60,000, and it is proposed to erect the plant on the line of the Boston and Albany Railroad, at a point near the Worthy grist mill. The franchise contains the stipulation that the works shall be finished by Jan. 1st, 1894, which looks to be all too short a time for their completion. The project will also have to secure the indorsement of the State Board of Gas and Electric Light Commissioners. West Springfield lies on the Connecticut river directly opposite Springfield, with which place it is connected by two or more bridges. Adjoining is the village of Mittineague. The population of West Springfield and Mittineague is about 7,000, and it looks that a gas works ought to do a fairly good business there.

AT the annual meeting of the Amherst (Mass.) Gas Company Mr. Charles Deul was re-elected President and Treasurer, Mr. George Cutter (the former Treasurer) having declined a re election.

SOME days ago the Massachusetts Gas Inspector called on the Pittsfield (Mass.) gas works for the purpose of testing the Company's gas; and on leaving he announced the fact that its lighting value was equal to 25 candles.

A POSITIVE move toward cheaper gas in Philadelphia was made some days ago by the introduction to Select Councils of an ordinance by Mr. McMurray which provides that after January 1, 1894, the rate for gas shall be $1 per 1,000 cubic feet. In addition, property owners are required to deposit a sum of money sufficient to cover one-quarter's probable bill, the deposit to remain until the use of gas is no longer desired, when the deposit is to be returned, less any amount that may be due for gas. The ordinance was referred to the Committee on Gas. While it is not probable that the $1 rate will be adopted, it is reasonably certain that action putting the price at $1.25 will be taken.

THE following is the reply of the Directors of the Detroit Gas Company to the Common Council, refusing to accept the terms of the ordinance under which it was proposed to regulate the manufacture and sale of gas in the city by the Company:

Gentlemen—The Detroit Gas Company has up to this time said very little as to its side of the controversy into which it has been unjustly forced, with reference to its right to do business and supply the inhabitants of the city with gas. When it purchased the plants of the old gas companies it found that consumers were being charged $1.50 per 1,000 cubic feet for gas, and especially with reference to that furnished on the east side of Woodward avenue, the gas was of very inferior quality. Desiring to increase the output and consumption of gas in the city, and gain the goodwill and friendship of its customers, the Company on the very day that it took possession of its property, reduced the price of gas from $1.50 to $1.25 per 1,000, making a net reduction in the gross revenue of the Company upon the present consumption of gas of $60,000 per annum. At the same time the Company made a substantial improvement in the quality of gas furnished, increasing it from 14 candle power to 18 candle power on the east side of Woodward avenue, and from 18 candle power to 21 candle power on the west side of Woodward avenue. This involved an increase in the gross cost of the manufacture of $230,000 per annum, making a total reduction in the net revenues of the Company of about $80,000 per year, the whole benefit of which was received by the consumers. These facts are stated simply as indicating that the Company was not animated with a desire to oppress the public, but, on the contrary, recognized that the goodwill of its customers was a desirable thing to have, and could only be obtained by fair, reasonable treatment, and a recognition of their right to have gas furnished at as reasonable rates, and of as good quality, as the people of other cities in like circumstances situated.

In addition to recognizing the wisdom and justice of reducing the price of gas and improving the quality of gas as above stated, the Company also considered the duty which it owed to the public of extending its pipes and mains on many miles of the streets where the people have been asking for gas for a number of years. It had come under the observation of the new owners that there were upwards of 50 miles of street within 1½ miles of the City Hall thickly settled, without gas, and in many of the localities residents have been endeavoring for years to secure the extension of the pipes without success. These extensions the Company determined to make, and contracts for the purchase of pipe and other material necessary for the extension were practically closed, and the work would now have been substantially completed but for the unreasonable and, we think, unjust treatment which the Company has received at the hands of the city authorities. This Company's plans contemplated the expenditure during this year of fully a million of dollars in this city if it had been permitted to prosecute its business as in law and justice it was entitled to do, and fully three-fourths of that amount would have been paid in wages to laborers employed upon the work.

Before the present Company purchased the gas business in this city it caused a careful investigation to be made by competent lawyers into the character of the grants held by the various companies which it acquired, and of the legal rights which they have to vend and sell gas in the city of Detroit, and it was then, and now is, satisfied that it has the undoubted legal right to do a gas business in this city under existing grants and ordinances for many years to come, and such rights as warranted them as conservative investors of their own and other people's money in purchasing the property at what they considered a reasonable price. Before purchasing the property they had the existing plants of the artificial illuminating gas companies carefully examined by competent gas engineers, and were assured that the plants which they contemplated purchasing could not be duplicated for less than $2,000,000. Considering that a reasonable valuation of the plants, they purchased them, and while a very much greater sum than that was paid, still, for the purposes of this argument, we will concede that figure as a fair basis upon which to discuss the question of the reasonableness of the ordinance of Aug. 15 last.

This brings us to the question, Is the ordinance approved Aug. 15 last a reasonable one in point of price per thousand cubic feet to be charged for gas, and of the period of time for which it assumes to grant the right to the Company to do business in the streets?

The Company takes issue with the terms of the ordinance on these points, and stands ready to substantiate its position with reference thereto. It does not concede any new grants or franchises, so-called, are required by it or are necessary to enable it to continue doing business. Only because the passage of the ordinance conveys to the public the impression that the Company is not acting in a fair and reasonable manner toward its customers does it desire to lay before the public what it thinks are conclusive arguments against the reasonableness of the ordinance. In the first place it is to be considered what the Gas Company should receive as a fair and equitable return from its business. It can very readily be seen that three factors are of paramount importance in determining that question: 1. The net cost of the manufacture and distribution of gas per 1,000 cubic feet. 2. The annual consumption of gas. 3. The period for which the Company has the right to maintain its pipes in the streets and distribute and sell gas.

It is also necessary to consider the cost of the construction and equipment of the plant for the manufacture and distribution, because if the right to do business and use the plant put in the ground is limited to a short period—say 15 years—then there must be included in the price charged to the consumer the net loss in its capital account sustained by the Company by reason of its having to lose a large portion of the cost of its equipment at the expiration of the franchise. In other words, if the plant to manufacture and distribute gas costs $2,500,000, and the right to use the plant and do business existed for only 15 years, in the very nature of things one of the items which would have to be provided for by being included in the cost of gas to the consumer would be the loss which the Company would sustain by the fact that fully 60 per cent. of the capital which it had invested would be destroyed by the termination of its business. All that the Company would have on its hands at the expiration of the franchise would be a plant depreciated by wear and tear and decay, without any right to use it; and experience shows that the depreciation amounts to fully 5 per cent. of the cost per year over and above repairs; and the Company could only realize therefrom such a sum as it would sell for to its successor in the business, if the successor were willing to buy. It is thus seen that the shorter the life of the franchise the greater will be the reduction in price. In this lies the unsoundness and lack of wisdom in the provision of the ordinance of August 15, limiting the right of the Gas Company to use the streets of the city to 15 years, because, as stated above, into the period of 15 years has to be crowded the loss which the Company will sustain in the depreciation of its plant and the destruction of its business at the end of that period. In the hands of an existing Company, doing business, the plant would always be of very much greater value than could be realized from it by a sale to a succeeding Company, if the first Company is compelled to go out of business and make a forced sale of its plant, and in addition to the loss of its plant the Company would inevitably sustain the loss of a very large portion of the sum expended in the building up of the business. The net price of 80 cents per 1,000 cubic feet fixed by the ordinance is unreasonable, and no Gas Company can furnish gas of 18-candle power at that price to the citizens of Detroit. It has been said by members of the committee through the public prints that the price fixed by the ordinance is based upon estimates and statements as to the cost of the manufacture and distribution of gas, furnished by an alleged expert in the city of Cleveland. The cost of the manufacture and distribution of gas at Cleveland is placed by this expert at 46 cents per 1,000 cubic feet. It is conceded by the committee that an addition must be made to this price to the extent of about 4 cents per 1,000 cubic feet on account of the extra cost of coal in Detroit. The item of taxation is not included in the estimate of cost made by this expert, which item in this city under the general law and the ordinance of August 15 would amount to 11 cents per 1,000 cubic feet, on the present consumption of 230,000,000 cubic feet. This would bring the net cost of gas in this city to 61 cents per 1,000 cubic feet, leaving a net balance of 19 cents per 1,000 cubic feet, making on the present consumption in Detroit, in round figures, $45,000 per year. From this the Company must pay all incidental damage claims, losses from bad debts, insurance, office and administrative expenses. The net residue, making no allowance for replacements, improvements and extensions, would not suffice for an annual dividend of 2 per cent. upon the valuation which has been placed upon the artificial gas plants of this Company by the Board of Assessors of Detroit, for the purposes of taxation for this year. Surely it requires very little business judgment to see that as at present situated the Company could not continue to do business on such returns.

Conceding the claim that there would be a large increase in the consumption of gas were the price reduced to 80 cents, and that in a greater or less degree a reduction in the net cost of manufacture and distribution would follow any marked increase in the consumption, it would not follow that the reduction in cost would amount to any material sum less than the estimate made by the Cleveland expert, because it must be borne in mind that his figures were based upon an annual consumption in that city of 600,000,000 cubic feet, being 2½ times as much as the present total consumption in this city, a figure which could only be reached after the expenditure of a large sum in the extension of lines, thus involving the investment of a large amount of additional capital. It may be safely said that no appreciable reduction, therefore, would be had in the cost of the manufacture and distribution under the figures above stated for five years to come.

It is conceded in all municipalities where the price to be charged for gas is a matter of municipal regulation, and especially in Europe, that from 8 to 12 per cent. on the capital invested is not an unreasonable profit in the gas business. This is due to risk attending the business and among others to the fact that the companies have to carry their own insurance, as the insurance companies consider the risk too hazardous. It therefore appears that before any Company could pay an ordinarily reasonable dividend on said $2,000,000 it would have to manufacture and sell in the City of Detroit not less than 1¼ billions of cubic feet of gas (being about 5 times the present) at the price fixed by the ordinance of August 15, 1893. It must be remembered in this connection that this does not provide for a single dollar going into a sinking fund to take care of the loss in the capital of the Company which it would sustain immediately upon the expiration of its franchise and the termination of its right to do business and use its property.

This Company contends that the figures of the Cleveland expert, upon which the committee acted in fixing the price at 80 cents, are utterly unreliable, although used for the purposes of the foregoing computation.

The State Gas Commissioner of Massachusetts made a statement under oath in Cleveland, and undoubtedly based upon returns from the Gas Companies throughout the state, of the net cost of the manufacture and distribution, not allowing for taxation and other incidentals, from which it appears that the net cost would be about 50 cents per 1,000.

The Massachusetts estimate allows but 17 cents per 1,000 cubic feet

for wages, while the actual cost of wages in Detroit is 23 cents per 1,000 cubic feet. Allowing all the other items in the manufacture and distribution to be alike in Massachusetts and in Detroit, we find on that basis the cost in Detroit would be about 6 cents greater, making a total cost of 56 cents, to which must be added the taxes in Detroit of 11 cents per 1,000 cubic feet. This makes the net cost on that basis in Detroit, on the present consumption, 67 cents per 1,000 cubic feet, or a balance of 13 cents to be carried to profit account. If gas is sold at the price fixed by the ordinance, or a total of about $30,000 per year on the present consumption. This would require a consumption of 1,750,000,000 cubic feet annually in this city, or more than 7 times the present consumption, to pay what is conceded to be a fair dividend on say $2,000,000 invested, an amount of consumption which will in all human probabitity never be reached in Detroit. This total profit of $30,000 would pay a dividend of about 3½ per cent. on the present assessed valuation of the property, taking no account of losses. From this the Company must pay all incidental damage claims, losses from bad debts, insurance, office and administrative expenses. What would be left after these expenditures are met?

The object which the Common Council should seek is to obtain for the gas consumers as good a quality of gas for as low a price as can be procured, consistent with sound business principles. Giving the Common Council credit for acting from the purest and most public spirited motives in the passage of the ordinance of August 15, we think they have lost sight of one of the most important factors in the question, viz: that the longer the term of the franchise the cheaper the Gas Company can afford to furnish gas. The importance of this cannot be overestimated. It is one of the controlling factors in Cleveland. The right of the Cleveland Gas Company to do business—its franchise in the streets—is conceded to be perpetual, and the city is given the power from time to time to regulate and fix the price of gas. This power of the city has been restricted by the court to fixing a price at which the Company can make a reasonable profit on the capital invested. It is of no particular moment to the consumer who furnishes the gas so long as he is well served. The period of time which a Company is permitted to use the streets is of controlling importance. It costs as much to construct a plant to work under a 15 year franchise as for one of 50 years. The advantage to the consumer lies in the long term, because it enables the Company to take the full 50 years to recoup for its capital, whereas with the short one it must be done in 15 years, resulting in the increase of the price of gas to the consumer.

Counting upon the willingness of the people of Detroit to see investments in Detroit as safe and profitable as like investments in other cities, we would next compare certain conditions which prevail in Detroit and neighboring cities.

It is admitted by all observers that in none of the cities which would be selected for comparison with Detroit, is electricity so generally used for public and private illumination as in Detroit. Cities as consumers of gas in the streets, parks and public edifices are among the most profitable customers of gas companies. It may be stated that the amount of gas to be purchased annually for the public use by a city in which gas works are about to be established is a question of first importance. In the cities of Buffalo, Cleveland, Chicago and Milwaukee the cities themselves consume upon the average more than 15 per cent. of all the output of the companies. In Detroit the situation is less favorable. For years not one dollar's worth of gas has been used in the streets and the amount consumed in public offices is not worth mentioning.

Further, the competition of electricity has cut off the profitable business of lighting hundreds of stores, manufactories and warehouses, and the lighting of nearly every theater, hotel, clubroom, barber shop, saloon, restaurant and place of amusement or resort in the city of Detroit, where quantities of light are used, and long hours prevail. In addition, electric light is supplanting gas for the illumination of scores of dwellings of a class which would otherwise rank among the best customers of the Gas Company.

The entire loss of city patronage and the inroads of electricity explain the vast disproportion which exists in Detroit between the total miles of gas pipes (not counting any duplication of pipes resulting from the gas war of 20 years ago) and the total of gas distributed through the pipes per year, as compared with the total mileage and output in other cities. There is no other considerable city in the Union in which there is so small a volume of gas consumed by the inhabitants for the investment in street mains as in the city of Detroit.

With the custom of the city entirely gone, and with the patronage of the most profitable class of consumers largely lost, through the competition of electricity, it results that the Detroit Gas Company must increase the volume of its business by the addition of consumers who are individually less profitable. Now, consumers must be householders. It is manifest that a very large number of consumers of that class, which is the only class remaining open for the Company, would be required to compensate for any further reduction in the price of gas, or to cause any marked increase in the output of the Company; and that the Gas Company of Detroit will doubtless long maintain its unenviable record of having an unexampled investment in street mains for the volume of its yearly business.

There is another consideration which should appeal to the fairness of the people of Detroit.

Every enterprise launched in Detroit which involves the use of more capital than can be procured in Detroit becomes at once subject to the rigorous laws which pertain to all investments. Investors at home and abroad look first to the safety of principal, and next to the certainty and amount of interest on dividends. In every enterprise where something is to be produced which is expected to be sold at a profit, both the safety of principal and the certainty of income depend upon the permanence of conditions at least equally favorable to those which prevail when the investment is made. The public cannot fairly expect an investment of money to be made in a permanent plant suitable only for supplying some public want, without guaranteeing to the parties who are willing to make such investment, immunity from interference by the public authorities with the conditions which induced them to make the investment, for such a period of time as investors have found by experience to be necessary to make the investment safe and profitable. It will soon become known to anyone who seeks to induce capital to invest in gas property, that investors must be satisfied at once that the rate at which gas may be sold is profitable, and that there can be no change made without their consent in that rate for a long period of time. The longer the period of time, as hereinbefore argued, the less the rate may be. Other cities have accepted the verdict of investors upon this point, and in Buffalo, Cleveland, Chicago, Toledo, Milwaukee and Sandusky the rights which the existing companies have to continue the gas business are perpetual.

It is self-evident that no advantage to the city is lost by contracting that a permanent plant may be used permanently, so long as there is any demand for its use. The city retains the right to grant equal privileges to all new comers.

Not only must there be reasonable assurance of permanence of the right to do business, but the rate must be reasonably liberal. No merchant would contract to sell the city coal or wood for a period of years at the lowest market price prevailing at the time the contract was entered into. Fluctuations in values must be taken into account.

The records of your honorable body disclose facts which furnish a cogent argument upon this point. In 1851 the Detroit Gas Light Company contracted with the city as to gas rates for the period of 10 years. In 1861 a new contract as to rates was entered into to endure for 5 years. The rate was lower than that of 1851. In 1864 a Special Committee of the Council reported after investigation that the cost of coal was then more than double its cost when the contract was entered into. The city added 50 cents per 1,000 to the low contract rate, but the Company was obliged to continue to supply private consumers at a loss during the life of that contract. Your records show that the Company declined after that and upon the ground that it had been brought to bankruptcy by its time contract to enter into contracts at low rates for longer periods than one year; and it would appear that the reasons were deemed adequate, for from that time no rates but annual rates were agreed upon between the city and Company.

If the Detroit Gas Company should now contract to furnish gas at the rate mentioned in the ordinance under consideration for the period of 15 years, it would take upon itself all the risks of financial disturbances, of fluctuations in the cost of the materials which enter into the composition of gas. The consumption of coal and coal products is yearly increasing with the growth of the country, while the natural supply is surely diminishing. No prudent business man would undertake to say that the Detroit Gas Company for the period of 15 years could afford to furnish gas at the price fixed by the ordinance.

While it is essential that the rate should not remain subject to the arbitrary control of the Common Council or the Company, it is also essential that it should be reasonably liberal, in order that it may be reasonably safe and remunerative.

The attention of your honorable body is respectfully directed to the statement of Director Windrim, of the Gas Department of the city of Philadelphia, just submitted by the Mayor of that city to the Common Council in a message in which he recommends the reduction of the price of gas in Philadelphia from $1.50 to $1.25 per 1,000 feet. That statement shows that from an annual output of nearly 4,000,000,000 cubic feet, or over 17 times the amount sold in the city of Detroit, and with Philadelphia lying at the base of the coal measures, and with gas furnished of but 18-candle power, about 23 cents per 1,000 feet will be left as profit from the sale of gas at $1.25 per 1,000.

From the recommendation of the Mayor of Philadelphia it is obvious that in his judgment $1.25 per 1,000 is not an unreasonable price for gas and that 23 cents per 1,000 feet is not an unreasonable profit. The city of Philadelphia owns its own gas plant and sells to public and private consumers, and this recommendation was made after due consideration by it of the possibility of reducing the price to $1 per 1,000 feet. It was found that such reduction would involve the city in a loss of nearly $1,000,000 per annum, for according to Director Windrim, it cost in that city $1.02 per 1,000 feet to manufacture and sell gas, and the direct loss in supplying it at $1 per 1,000 and in making necessary extensions would involve a yearly deficit in the enormous sum just stated.

It is the mature judgment of this Company that it cannot accept the proposals of the city embodied in the ordinance of August 15, 1893.

THE death of Mr. Le Roy Haff, a prominent Director in the Bergen County Gas Company, of Englewood, N. J., is reported. His decease occurred at Paul Smith's, in the Adirondacks, where he had been enjoying his summer outing. He was prominent in the social affairs of Englewood, and was greatly respected.

WE are informed that Messrs. A. P. Storrs and George A. King, of Owego, N. Y., and Walter C. Godly, of Philadelphia, Pa., have purchased the works of the Owego Gas Light Company. Mr. A. P. Storrs has been elected President, and Mr. George A. King was chosen Secretary and Treasurer. Contracts for the rebuilding of the works have been awarded. The following new schedule of rates was adopted: When the monthly consumption amounts to 500 cubic feet, $3 per 1,000, less 33⅓ per cent. for prompt payment; gas used for fuel and power purposes, $3 per 1,000, less 50 per cent. for prompt payment.

FRANK W. TAYLOR, formerly Superintendent of the Westerly (R. I.) Gas Company, died at his home in Hartford, Conn., on the 24th inst.

THE AMERICAN GAS LIGHT JOURNAL

MONDAY, OCTOBER 2, 1893.

The Market for Gas Securities.

The market for city gas shares was very dull since time of last writing, with prices all on the low side. Consolidated was very uneven and the opening to-day (Friday) was made at 124½ to 125½. The cause of the slump is the general lack of confidence, which is almost as pronounced now as it was in mid-summer. An offer of a block of even less than 100 shares is viewed with more suspicion than an offer of 1,000 shares would be in ordinary times; meanwhile we can and do authoritively say that the Company was never in better condition, that it is ready on every side for the coming winter's business, and that its affairs were never better managed nor under more perfect control. Mutual is fairly steady and Equitable is in some demand. We note a sale at auction this week of 10 shares Standard preferred at 61—a very great bargain for the buyer.

The Brooklyn situation is very much mixed, and prudence would seem to dictate that the least said about it the better it will be for all concerned. Prices are all on the weak side. The Equity Construction Company has declared a dividend of 30 per cent. in stock and bonds of the Equity Gas Light Company, payable on October 30th. Baltimore Consolidated sold down to 56, Chicago gas, after selling close to 50 during the week, opened to day at 57½ to 57⅞, and Bay State is reported at 17 to 17½. The decree of the Commission in the matter of adjusting the $4,500,000 note may be looked for by October 20th.

Gas Stocks.

Quotations by Geo. W. Close, Broker and Dealer in Gas Stocks,

16 Wall St., New York City.

October 2.

☞ All communications will receive particular attention.
☞ The following quotations are based on the par value of $100 per share.

	Capital.	Par.	Bid	Asked
Consolidated	$35,430,000	100	124½	125½
Central	500,000	50	90	95
" Scrip	220,000	—	—	100
Equitable	4,000,000	100	155	160
" Bonds	1,000,000	—	106	108
Harlem, Bonds	170,000	—	—	—
Metropolitan, Bonds	658,000	—	110	115
Mutual	3,500,000	100	—	135
" Bonds	1,500,000	—	100	102
Municipal, Bonds	750,000		—	—
Northern		50	—	—
" Bonds	150,000	—	—	100
Richmond Co., S. I.	346,000	50	—	—
" Bonds	20,000	—	—	—
Standard Gas Co—				
Common Stock	5,000,000	100	—	40
Preferred	5,000,000	100	—	80
Yonkers		50	112	—
Gas Co's of Brooklyn.				
Brooklyn	2,000,000	25	—	105
Citizens	1,200,000	20	50	—
" S. F. Bonds	320,000	1000	—	103
Equity Gas Light Co	2,000,000	100	—	—
Bonds	1,000,000	—	—	—
Fulton Municipal	3,000,000	100	125	—
" Bonds	300,000		102	—
Peoples	1,000,000	10	—	85
" Bonds (7's)	368,000	—	100	—
" " (6's)	94,000	—	100	—
Metropolitan	870,000	100	—	120
" Bonds (5's)	70,000	—	100	—
Nassau	1,000,000	25	—	150
" Ctfs.	700,000	1000	99	100
Williamsburgh	1,000,000	50	—	125
" Bonds	1,000,000	—	107	110
Out of Town Gas Companies.				
Boston United Gas Co.—				
1st Series S.F. Trust	7,000,000	1000	—	60
2d " " "	3,000,000	1000	40	—
Bay State Gas Co.—				
Stock	5,000,000	50	17	17½
Income Bonds	2,000,000	1000	40	—
Buffalo Mutual, N. Y.	750,000	100	110	—
" Bonds	200,000	1000	95	100
Citizens, Newark	1,000,000	50	155	160
Chicago Gas Company.	25,000,000	100	57½	57⅞
Chicago Gas Light. & Coke Co.—				
G't'd Gold Bonds	7,650,000	1000	85	90½
Equitable Gas & Fuel Co., Chicago, Bonds	2,000,000	1000	—	101
People's Gas and Coke Co., Chicago—				
1st Mortgage	2,100,000	1000	—	108
2d "	2,500,000	1000	104	105
Consumers Gas Light Co., Jersey City	2,000,000	100	—	30
Bonds	600,000	1000	—	85
Cincinnati G. & C. Co.	7,000,000	100	192	—
Consumers Toronto	1,600,000	50	190	191
Central, S. F., Cal.			—	100
Capital, Sacramento, Cal			—	55
Consolidated, Balt.	11,000,000	100	55¾	56
" Bonds	6,400,000		107	107½
Citizens Gas Lt. Co., Rochester, N. Y.	500,000	—	85	101
Bonds	250,000		—	—
Detroit Gas Co.—				
1st Mortgage			25	—
East River Gas Co., Long Island City	1,000,000	100	100	105
Bonds	500,000	100	100	102
Hartford, Conn.	750,000	25	120	128
Jersey City	750,000	20	190	200
Laclede Gas Light Co., St. Louis, Mo.—				
Common Stock	7,500,000	100	14½	15
Preferred "	2,500,000	100	55	60
Bonds	9,034,400	1000	78	78½
Louisville, Ky.	2,570,000	50	125	130
Little Falls, N. Y.	50,000	100	—	100
" Bonds	25,000	—	100	103
Montreal, Canada	2,000,000	100	200	208
Memphis (Tenn.) Gas	750,000	100	30	—
" Bonds.	240,000	100	103	—
New Haven, Conn.		25	200	—
Oakland, Cal.			42⅜	43
Peoples, Jersey City		—	160	170
" " Bonds.			—	—
Paterson, N. J.		25	99	102
Rochester, N. Y.		50	80	85
Preferred			90	95
Bonds			90	95
Syracuse, N. Y.	500,000	25	—	—
San Francisco Gas Co. San Francisco, Cal.	10,000,000	100	71½	72¼
Washington, D. C.	2,000,000	20	240	240
Wilmington, Del.		50	59	88

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GAS STOVES.

American Meter Co., New York and Philadelphia..... 487
The Goodwin Meter Co , Phila., Pa 468
George M. Clark & Co., Chicago, Ills..... 485
Maryland Meter and Manufacturing Co., Baltimore, Md.... 502
The Schneider & Trenkamp Co., Cleveland, O..... 481

Position Wanted.

A thorough and experienced

Gas Engineer and Superintendent

is open for engagement. Address

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FOR SALE,

Two Ten-Inch Dry Center Seals,
in good condition, and one
Small Multitubular Condenser,
4 ft. diameter and 14 ft high.

For particulars inquire of FRED. BREDEL, C.E.,
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DIVIDEND NOTICE.

STANDARD GAS LIGHT CO. OF THE CITY OF NEW YORK,
71 BROADWAY, NEW YORK, Sept. 13, 1893.

At a meeting of the Board of Directors of the Standard Gas Light Company, held this day, a dividend of one (1) per cent. was declared on the Preferred Stock, payable October 2, 1893.

Transfer books will close Monday, September 25, at 3 o'clock P.M., and reopen Tuesday, October 3, at 10 o'clock A.M.

954-3 FERDINAND McKEIGE, Secretary.

FOR SALE, CHEAP,

Second-Hand Exhauster, capacity, 100,000 cubic feet per day; 8-inch connections.
One-Horse Power Otto Gas Engine.
One Set of Purifying Boxes, 8 ft. by 8 ft. by 3 ft. 8-inch outlets and inlets.
All in good condition. Address YOUNGSTOWN GAS CO.,
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Utilize Your Gas Liquor.
NO EXTRA LABOR OR OPERATING EXPENSES.
Ammonia Concentrator.
Not Expensive. Write to
STROH & OSIUS, Pat'ees, or
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MANUFACTURERS OF

VALVES,

Double and Single Gate, ¾ in. to 72 in., outside and inside Screws. Indicator, etc., for Gas, Water, Steam, Oil and Ammonia.

SEND FOR CIRCULAR.

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Hydraulic Main Dip Regulators, Check Valves, Foot Valves, Yard Wash and Fire Hydrants.

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The undersigned will sell, to the extent of $20,000 to $50,000, in sums to suit purchaser, an interest in a growing gas business now netting 8 per cent.; increase this year will give net earnings of over 12 per cent. Money wanted for extensions to cover valuable territory. A magnificent opening for a party desiring a permanent occupation and investment in one of the most pleasant residence locations in California. Banks and business firms as references. Address for particulars and statement,

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DURABLE.
LIGHT.
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Gas Governors,
Governor Gas Burners,
Gas Cocks and Fittings.

In addition to a full assortment of Volumetric Governors, etc., I am now making **MERCURY PRESSURE GOVERNORS** of all the usual sizes, adapted to use upon *Gas Stoves, Furnaces, and Meters*. The same careful attention to details of design and workmanship which has established the reputation of **WILDER'S VOLUMETRIC GOVERNORS** will be given to the new line. They have been thoroughly tested in many places during the past year, and have given entire satisfaction. The price is very low, and but for a complete system of machinery adapted to this work, it would be impossible to sell them at the price. I hope for large orders, as they become known, in consequence of the low price and good quality.

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Valves and Gates for Gas, Ammonia, Water, Etc.

Also, Gate Fire Hydrants with and without Independent Nozzle Valve. All Work Guaranteed.

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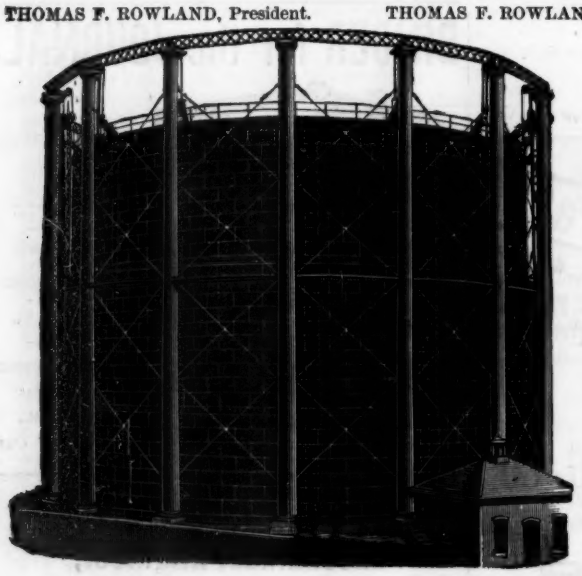

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New Designs and

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The Largest and Most Complete Line ever Manufactured Under one Name.

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For 1893-94.

Send for Catalog of the Most Artistic Line of Heaters on the Market.

The New Double Reflector is Worthy of Attention.

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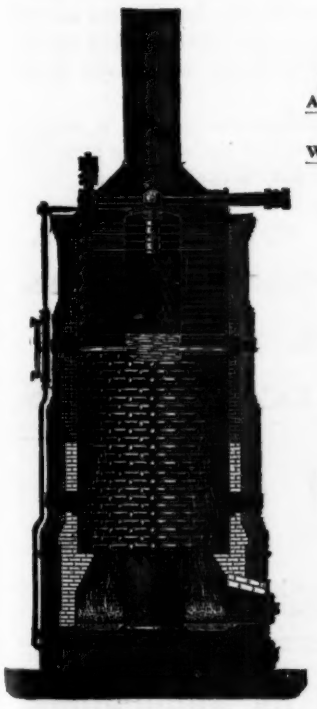
The HAZELTON BOILER Frequently Called The PORCUPINE BOILER

Patented in America and Abroad.



100,000 HORSE POWER

of this Justly Celebrated Water-Tube Boiler in Successful Operation in all the Principal Industries.

An Unparalelled Record, of Over Twelve Years, for Economy, Durability, Safety, and Efficiency.

A Common-Sense High-Pressure Boiler made in a Superior Manner.

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THE HIGHEST STANDARD OF EXCELLENCE.

Standard Sizes, 50 H.P. to 500 H.P.

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THE PORCUPINE BOILER.
TRADE MARKS.

Special Sectional Boilers For Export.

The only Genuine Hazelton or Porcupine Boilers bear our Three Registered Trade Marks.

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This Company is prepared to Manufacture and Furnish Plants of Boilers of any desired capacity, and will forward proposals and other information on application. All imitations of the substantial features of this Boiler are infringements, and will be prosecuted to the full extent of the law.

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Sole Proprietors and Manufacturers, NEW YORK, U. S. A.

Cable Address, "PAILA," NEW YORK. **WRITE FOR ILLUSTRATED CATALOGUE. Correspondence Solicited.** **Long Distance Telephone, 1229-18th St., New York.**

This Boiler is producing unequaled results in the works of most of the principal Gas Co.'s of the U.S., and in similar plants in Foreign Countries

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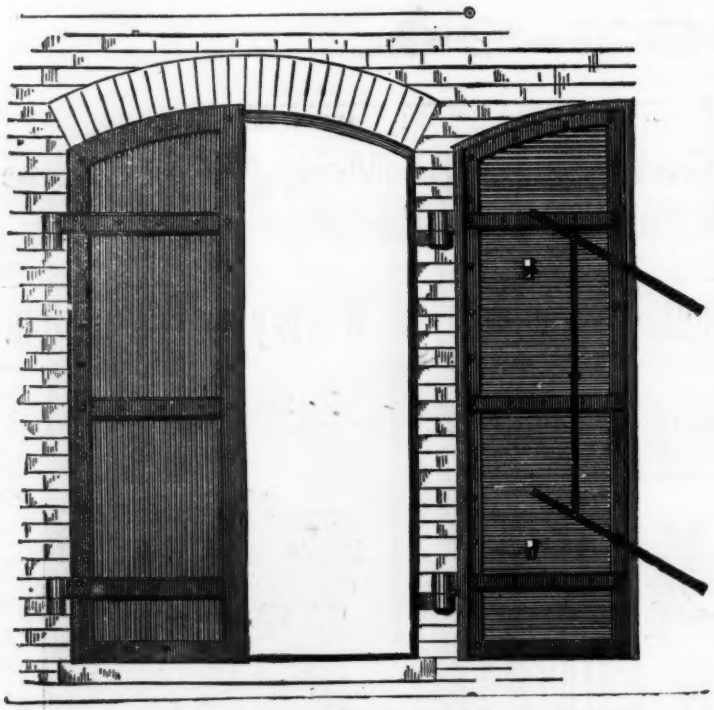

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HIGH CANDLE POWER

FROM

GAS.

MR. WALTON CLARK, Assistant General Superintendent, United Gas Improvement Co.:

Dear Sir—In accordance with your request, I have made several ests of the new Welsbach mantel (called No. 169) for candle power and efficiency, and I herewith submit the following results:

	Candle Power.	Pressure.	Gas Consumed.	C.P. per Cu. Ft.
Average of Test No. 1,	67.05	.95 in.	2.6	25.70
" " No. 2,	63.86	1.00 in.	2.86	22.30
" " No. 3,	72.50	2.1 in.	2.87	25.26

The above averages are the results of trials on three different occasions, and in each case the mantles tested were made from a different lot of fluid.

The mantles used in the above tests were selected at random, and all had been dipped in kristaline and dried ready for shipment.

It is quite possible that better results could have been obtained by manipulating and readjusting the position of the mantles on the galleries, and also by waiting a longer period after burning off the kristaline; but I considered such fine adjustment undesirable in determining the commercial candle power.

These tests were made on a bar photometer against a regular Edgerton standard slit. The candle power of the slit was 6.18, and the gas used was Gloucester City water gas, 26 candle power.

Very truly yours,

(Signed) C. H. PAGE, JR., M.E.

WE ARE NOW PREPARED TO FILL ALL ORDERS PROMPTLY FOR

HIGH CANDLE POWER WELSBACH LIGHTS.

Gloucester, N. J. **WELSBACH LIGHT CO.**

Newbigging's Handbook for Gas Engineers and Managers.

The present (the fifth) edition marks an important advance on those that have gone before. Considerable additions have been made to the text and much of it has been rewritten and otherwise improved. Price, cloth, $6.

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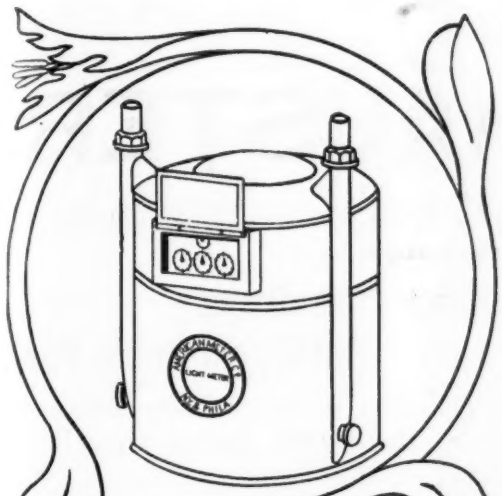

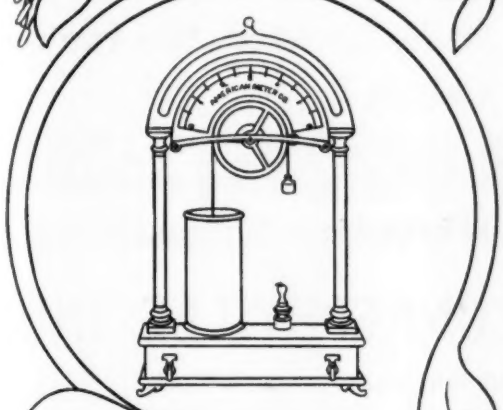

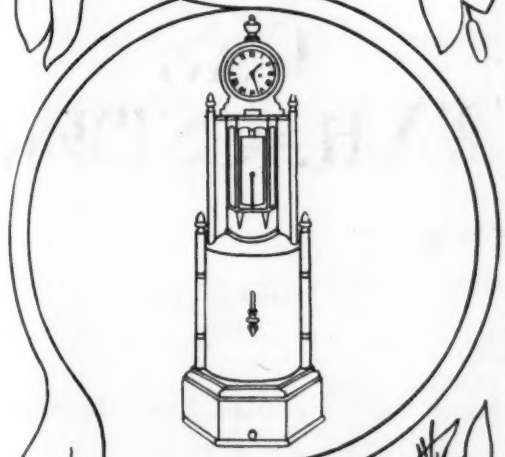

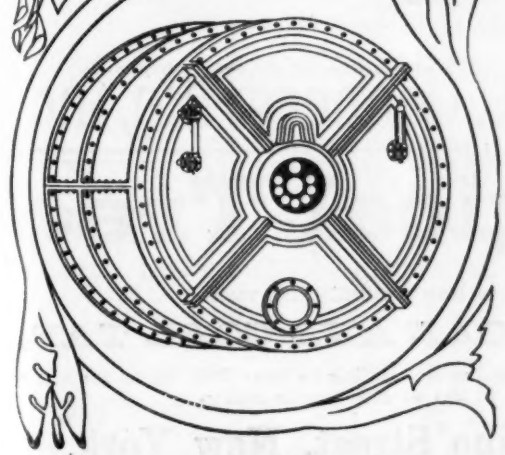

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NEW YORK and PHILADELPHIA.

CHICAGO, CINCINNATI,

ST. LOUIS, SAN FRANCISCO.

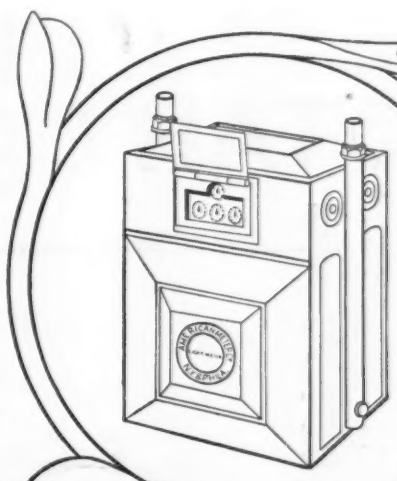
PUBLIC LIGHTING TABLE.

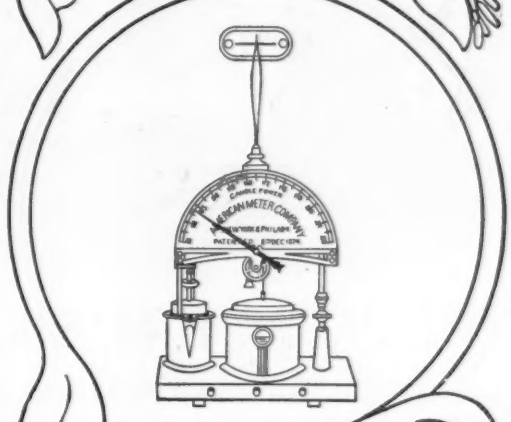
OCTOBER, 1893.

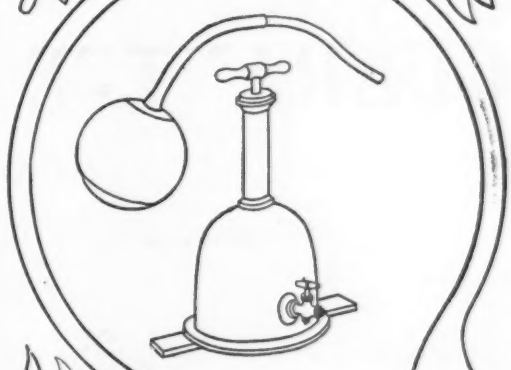
Day of Week.	Date.	Table No. 1. Following the Moon. Light.	Table No. 1. Following the Moon. Extinguish.	Table No. 2. New York City. All Night Lighting. Light.	Table No. 2. New York City. All Night Lighting. Extinguish.
				P. M	A. M.
Sun.	1	6.10 PM	10.40 PM	5.30	5.00
Mon.	2	6.10 LQ	11.40	5.30	5.00
Tue.	3	6.10	1.00 AM	5.30	5.00
Wed.	4	6.10	2.10	5.30	5.00
Thu.	5	6.10	3.20	5.30	5.00
Fri.	6	6.10	5.00	5.30	5.00
Sat.	7	6.00	5.00	5.30	5.00
Sun.	8	6.00	5.00	5.20	5.10
Mon.	9	6.00 NM	5.00	5.20	5.10
Tue.	10	6.00	5.10	5.20	5.10
Wed.	11	6.00	5.10	5.20	5.10
Thu.	12	6.00	5.10	5.20	5.10
Fri.	13	6.00	5.10	5.20	5.10
Sat.	14	6.50	5.10	5.20	5.10
Sun.	15	7.40	5.10	5.10	5.20
Mon.	16	8.40	5.10	5.10	5.20
Tue.	17	9.40 FQ	5.10	5.10	5.20
Wed.	18	10.40	5.10	5.10	5.20
Thu.	19	11.50	5.10	5.10	5.20
Fri.	20	12.50 AM	5.20	5.10	5.20
Sat.	21	2.00	5.20	5.10	5.20
Sun.	22	3.10	5.20	5.00	5.30
Mon.	23	No L	No L.	5.00	5.30
Tue.	24	No L	No L.	5.00	5.30
Wed.	25	No L FM	No L.	5.00	5.30
Thu.	26	5.30 PM	6.50 PM	5.00	5.30
Fri.	27	5.30	7.30	5.00	5.30
Sat.	28	5.30	8.30	5.00	5.30
Sun.	29	5.30	9.30	4.45	5.35
Mon.	30	5.30	10.50	4.45	5.35
Tue.	31	5.30 LQ	12.00	4.45	5.35

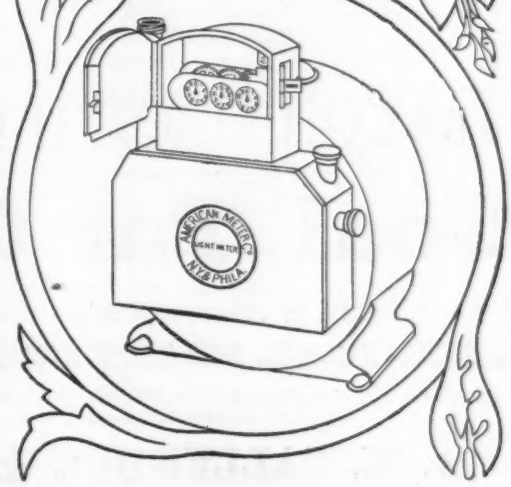
TOTAL HOURS LIGHTING DURING 1893.

By Table No. 1.	Hrs. Min.	By Table No. 2.	Hrs. Min.
January...	217.30	January...	423.20
February..	200.30	February..	355.25
March	177.50	March	355.35
April.....	160.30	April.....	298.50
May.....	149.00	May.....	264.50
June.....	140.30	June.....	234.25
July	143.40	July.....	243.45
August....	154.50	August....	280.25
September.	171.50	September.	321.15
October....	202.20	October....	374.30
November.	221.30	November.	401.40
December.	248.50	December.	433.45
Total..	2188.50	Total..	3987.45

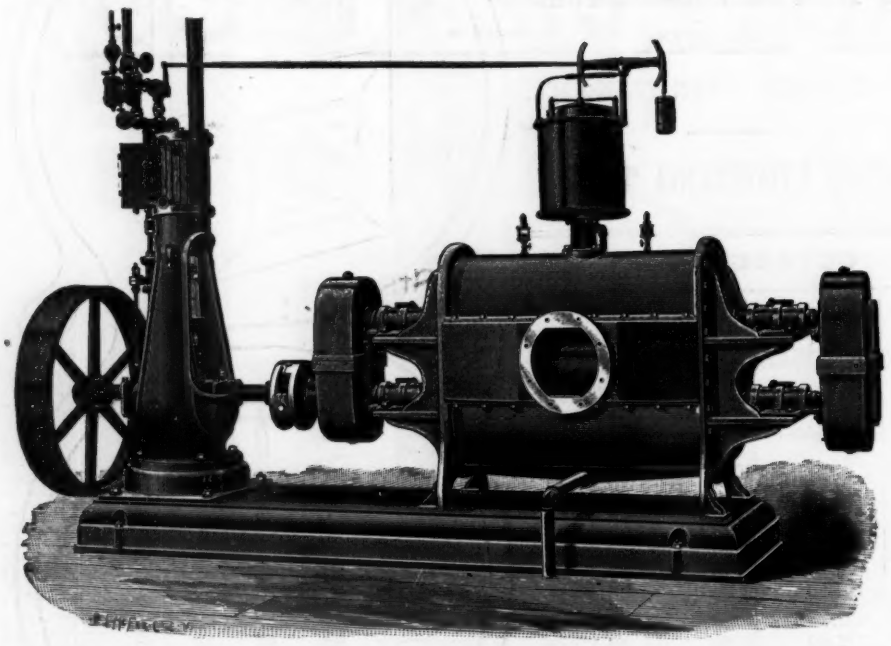








ROOTS' ROTARY GAS EXHAUSTER.



Our Exhausters sold from January 1st to August 1st have

A Daily Capacity of 31,160,000 Cubic Feet.

Our guarantee as to Durability, Efficiency, etc., is backed by our reputation and thirty years of experience.

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NOW ON THE MARKET.

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CYCLOIDAL EXHAUSTER,

the internal operating parts of which consist of two Revolvers, each p'aned accurately on cycloidal lines, the only Exhauster so constructed.

SIMPLICITY * EFFICIENCY * DURABILITY.

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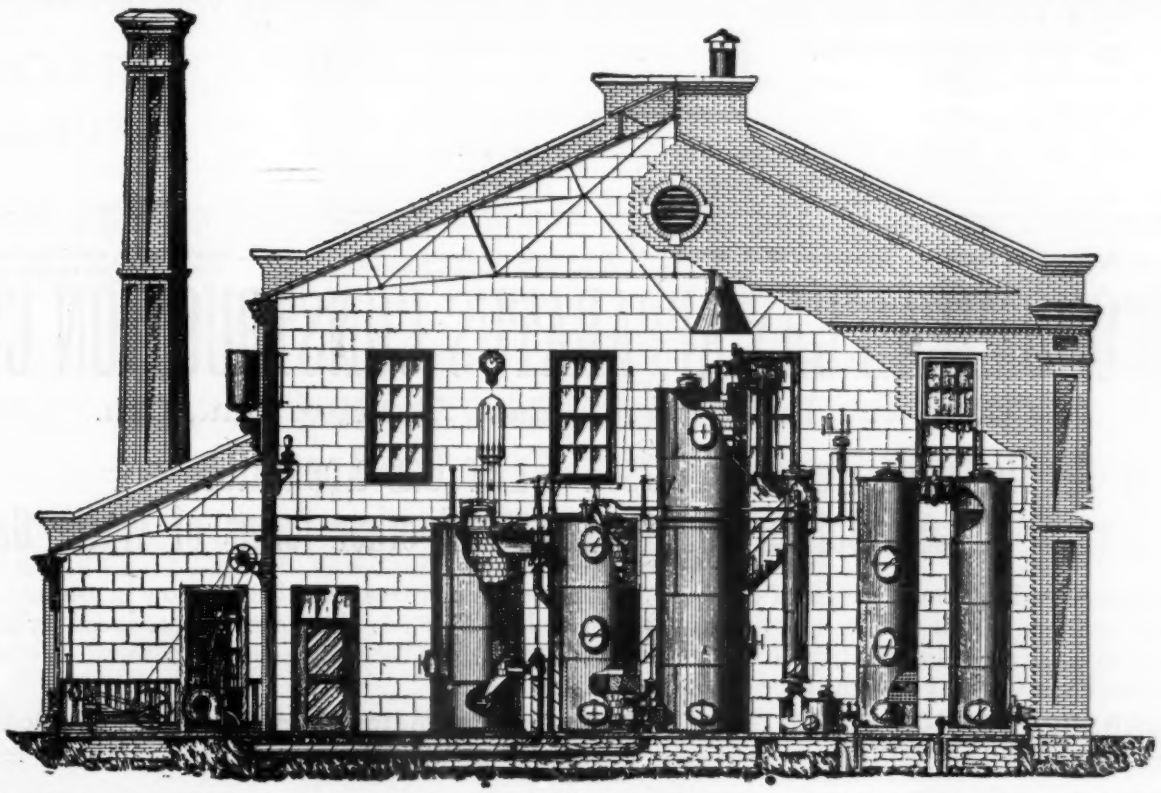

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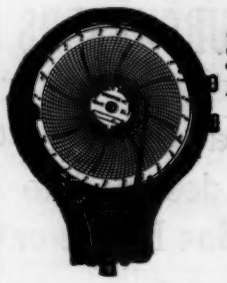

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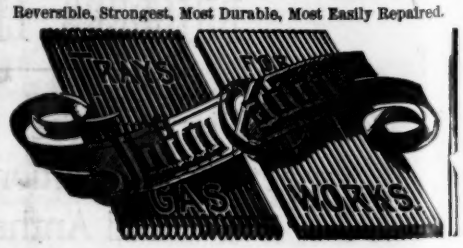

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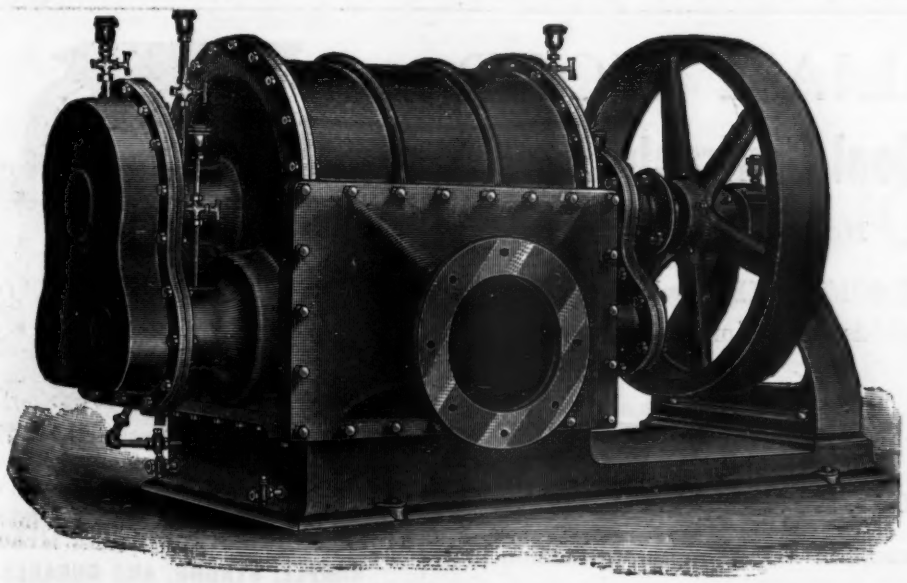

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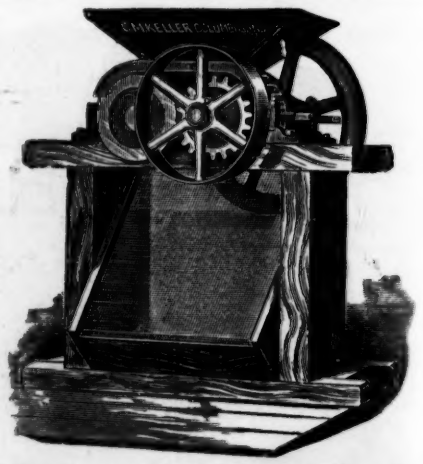

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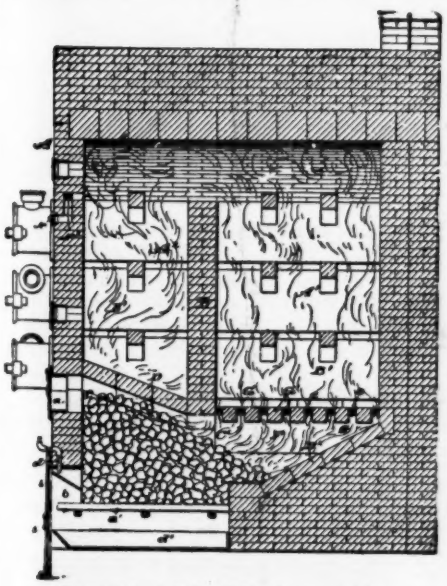

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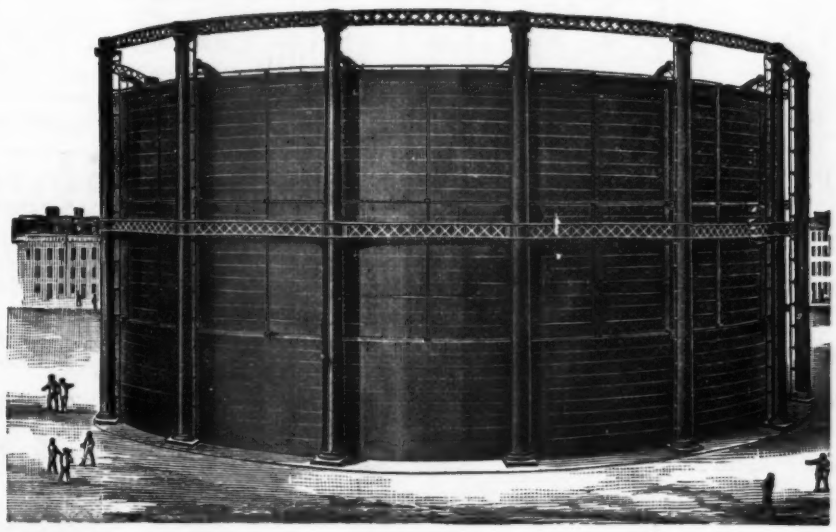

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Irvington, N. Y.	Montclair, N. J.	Bay Shore, L. I.	So. Framingham, Mass.	Bridgeport, Conn. (2d)
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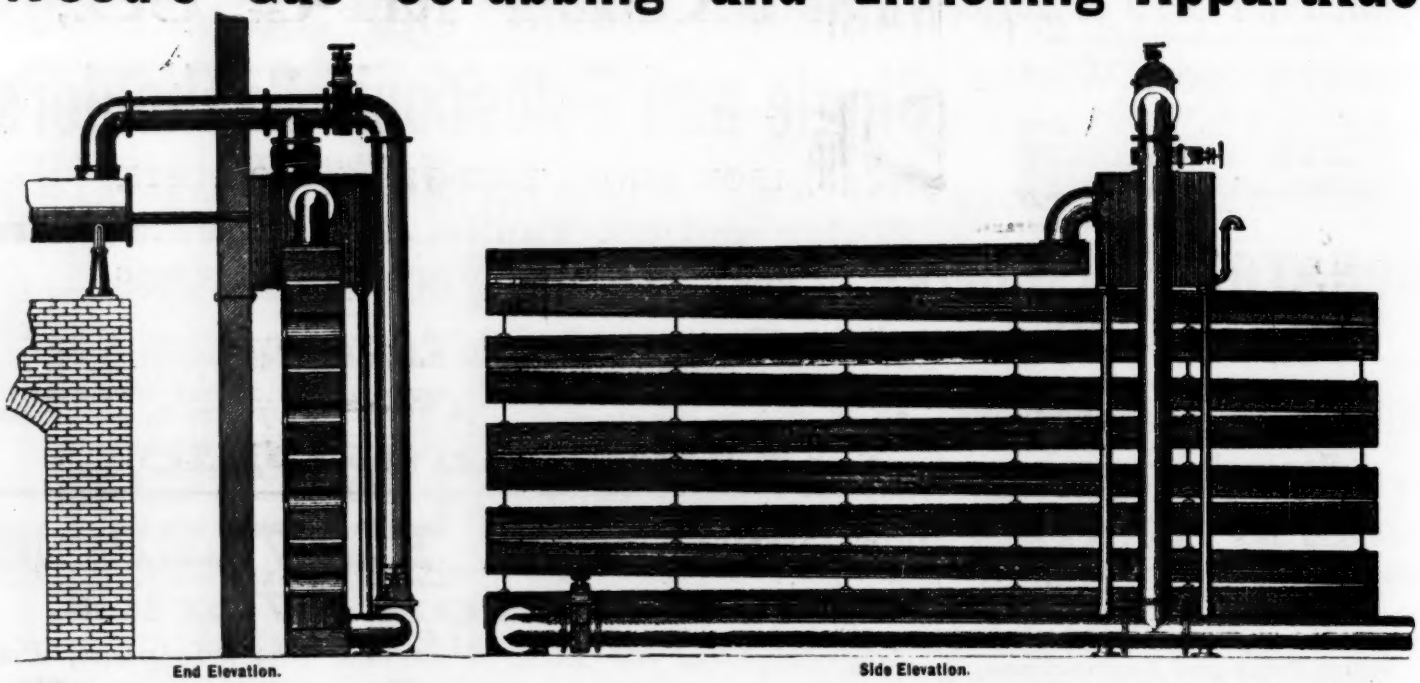

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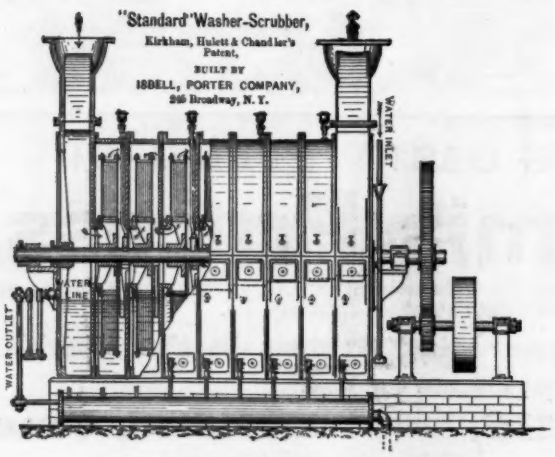

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For the Year 1892.

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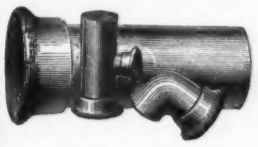

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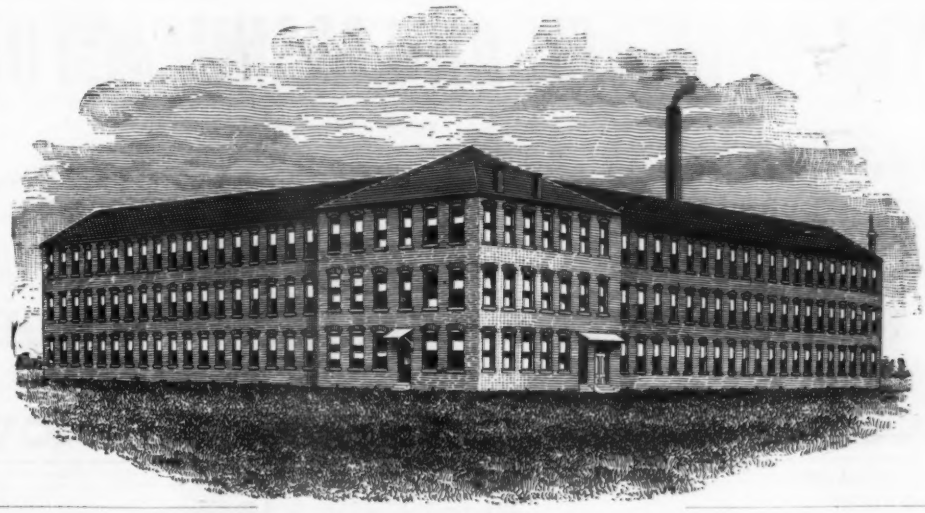

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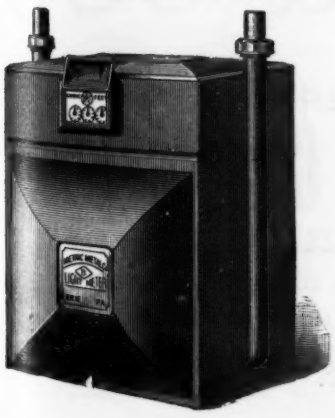

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